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Backroom Boys

Whilst the engineer is, because of mechanization, becoming more and more important in the foundry industry, yet the chemist remains of supreme importance in the day-to-day control of the production of castings. The control starts right back at the iron-ore fields, where the composition of the mineral must be determined in relation to its suitability for subsequent smelting. Moreover, variations must be quickly ascertained to enable a uniform product to be made. The chemist has also the control of limestone, fluxes, fuel, the wide range of non-ferrous ingots, and all types of refractories. Thus much of the work is done, and done remarkably well, before the raw materials reach the foundry, and, indeed, for the smaller units in the industry the certified analyses which accompany the raw materials form the basis of the foundry metallurgical control.

Within the industry, the chemist has to assume responsibility for taking care of the normal and abnormal variations which occur in consignments of raw materials received. Further, he must ensure that the metal cast complies with predetermined specifications. Very unfortunately, such service involves much routine work and wherever possible the scope of the chemist should be widened, as repetition work after a prolonged period becomes almost soul destroying. In many cases, spectrography and other modern methods can eliminate boredom and make his task interesting. Paradoxically enough, the better the control imposed, the more boring becomes the work, as the variation from normal reaches a minimum. If the chemist reacts intelligently to increased responsibility, his value to the firm will be greatly increased. It is of great worth if a young chemist can spend a period in the moulding and core-shops as an apprentice. He will then receive a better appreciation of metal/mould reactions, the influence of teeming speeds, and metal temperature. Through such a training he will be better equipped to reduce the troubles to be associated with the introduction of new processes. The major benefit, however, will be the widening of his outlook on foundry problems, whilst still retaining his essential scientific approach to manufacturing processes and their control.

There is still too little recognition of the important part which the chemist plays in the foundry industry and any help which can be given to him to reduce the routine nature of his work should be granted, especially in the smaller concerns. In the larger laboratories, girls can easily be trained to take over the day-to-day chemical determinations. The works' chemist should be encouraged to convert himself into a metallurgist in the fullest sense of the term, that is, to supervise the processing of raw materials into articles of commerce in such a way as to yield profit to his employers and lighten the labour involved.

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Decision Awaited

An interesting point arose recently in a case at Hitchin County Court concerning a claim for compensation. The man concerned was Mr. Herbert Sidney Adsett, aged 55, of Hitchin, and the sum involved was £970 1s. 11d., being costs he had been ordered to pay after he had, with his Union's aid, fought a claim for compensation in the High Court and then had unsuccessfully appealed against the dismissal of the claim. The judgment summons against him was issued by his former employers, K. & L. Steelfounders and Engineers, Limited, of Letchworth, defendants in the original action.

Outlining the facts, Mr. P. H. Ripman, counsel for K. & L., said Mr. Adsett had unsuccessfully claimed that he had contracted pneumoconiosis while employed as a foundry worker with the firm. He had been ordered to pay these costs. "We have the rather unpleasant task of seeing how he can pay them."

Giving evidence as to his means, Mr. Adsett told the Court that out of the £7 12s. weekly coming in, he had to pay £3 for lodgings, £1 towards the maintenance of his wife, and 4s. 4d. a week in bus fares; he had no banking account or savings. In reply to questions by Mr. Ripman, he said he did not know, when he brought the action against his employers, that he could seek legal aid. His Union conducted the case for him.

Costs not Mentioned

Mr. Ripman: They never told you that if you lost you might have to pay £100 or £1,000 in costs?—No.

Did they ever suggest that if there were any costs they (the Union) would pay them?—They never mentioned it.

You realize, Mr. Adsett, that, through no fault of your own, you are going to have this debt round your neck for the rest of your life?—Yes.

Would you have started those proceedings if this had been explained to you?—No.

You would have thought more than twice about it?—Yes.

Have the Union ever indicated to you that they are prepared to pay these costs?—No.

So far as you know, now the case is lost the Union have washed their hands of you?—Yes.

Addressing the Judge, Mr. Ripman said it would be fantastic to suggest that Mr. Adsett could pay more than a nominal sum. "I quite realize, and my clients realize, that any sum ordered to be paid by him is going to cause more hardship to him than it is going to benefit them, and they have great sympathy for Mr. Adsett," said Counsel.

The Judge said: "Mr. Ripman not unnaturally says that the Union, who are the cause of all this trouble, really, and are presumably a wealthy and powerful body, should be given an opportunity of considering whether they will make some contribution towards the costs.

"I think that is a sensible and proper suggestion. I am not suggesting there is a legal obligation."

The case was then adjourned to give the Union an opportunity of considering whether it would help to pay the costs awarded against Mr. Adsett.

Union Statement

A spokesman of the Union is reported to have stated: "We have not yet had details of this case, and each one is considered on its merits.

"The general position is that the rule which gives members a right to legal defence stipulates that the Union is not responsible for their costs.

(*Continued at foot of column two*)

"Rule 35, Legal Aid, states: 'In the event of the failure of such a claim [for damages] the National Council shall not be responsible for the payment of the successful defendant's legal expenses.'"

Conference Paper Author

HARRY W. DIETERT is the Author of the American Exchange Paper "'D' Process for Precision Castings," printed in this issue of the JOURNAL. A native of Texas, he received his early technical training at Iowa State College, Ames, Iowa, graduating in 1920 with a B.S. degree in mechanical engineering. He then spent two years at the Philadelphia works of the Westinghouse Electric and Manufacturing Company, subsequently serving as an instructor in charge of the shops at Rice Institute, Houston, Texas.

During 1922-23, Mr. Dietert carried on graduate work at the University of Illinois, receiving the degree of M.S. Following this, he accepted an appointment as plant engineer for the U.S. Radiator Corporation, Detroit, where he was instrumental in developing sand-control methods. In 1926, he was promoted to chief research engineer and in 1932 he became chief engineer. He served as a consultant engineer from 1938 to 1940. Since 1940 he has devoted all his time to his own manufacturing firm. He is the author and co-author of many technical papers dealing with sand testing and control, his work in this field being known throughout the United States as well as in Europe. In 1940 he was awarded the Wm. H. McFadden Gold Medal of the American Foundrymen's Society for his outstanding achievements in promoting interest in foundry sand research and control.

He has served on the A.F.S. sand research committee almost continuously since the committee was started in 1921 and has played a leading rôle in developing sand-control methods, in research work, in preparing technical literature on sand control, and in lecturing on this subject. As a member of the A.F.S. Committee, he has worked on the committee on conservation and reclamation, that on tests and the sub-committees on core tests; hardness testing and mould permeability; durability; grading and fineness; flowability and physical properties of foundry sands at elevated temperatures.

Forty Years Ago

In the issue of the FOUNDRY TRADE JOURNAL for September, 1914, there was a clarion call—reflecting the policy of the Government of the day—"Business as Usual." This was elaborated by a table showing German exports of foundry products to the countries of the world. Their best market was this country with over £1,000,000 gold in value. There is printed an abstract from the National Relief Fund to which foundries contributed very handsomely, headed by a gift of £10,000 from the late Sir Robert Hadfield. Apparently one of the first materials to be put on the list of prohibited exports was ferro-manganese. Cleveland No. 1 pig-iron was selling at 54s., foundry coke at 21s. 6d. and cast-iron floor plates at 71s. 6d. per ton.

As Slick as a Film Strip!

FORD COMPACTION MOULDING

By A. R. Parkes

Usually, slickness in operating a new process only comes after years of experience, but the Ford process of compaction moulding has attained this cachet of efficient production after a period when other projects would still be at the laboratory stage. It is a precision-casting process for which worthwhile economies are claimed in production costs of suitable components as compared with normal green-sand moulding. So far, actual day-to-day experience has been concentrated on rocker-arm castings made in pearlitic malleable iron, but the process is now at a stage when it can be extended to other items. The process is so logically set out at Ford's that the film-strip technique is followed as a basis for this account. Much intensive research and practical trial was needed, however, before the process reached the state of perfection described, and an attempt has been made to emphasize those points at which strict control is necessary.

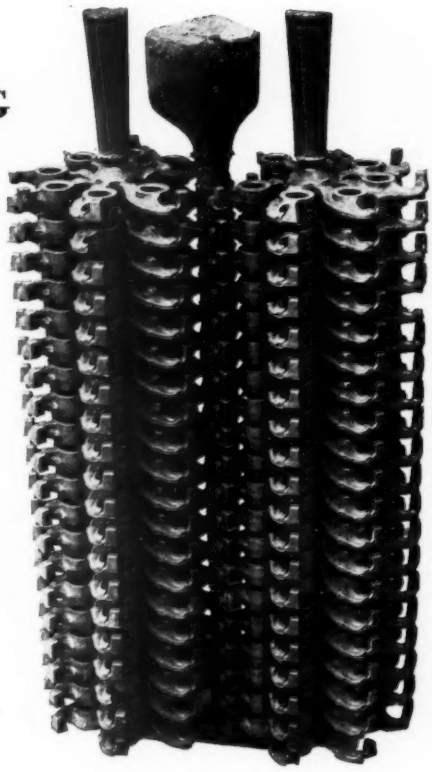


FIG. 1.—*Stack of* 280 *rocker-arm castings from one mould produced by the compaction process.*

The Process

Compaction moulding developed by the Ford Company* is something of a mixture of shell-moulding and orthodox cake-core production, the cores or cakes being arranged for stack assembly before pouring. In brief, a resin/sand mixture in controlled amount is spread into a heated metal bottom-half corebox containing numerous impressions of the rather shallow items to be cast. Sufficient resin/sand is so placed as to project about $\frac{1}{8}$ in. above the surface of the box. The corresponding top-half corebox, also heated, is then placed in position, locating on dowel pins. The assembly passes to a press head, where a squeeze load is applied, with the effect of compacting the resin/sand and closing the box assembly to a set internal depth.

The mated coreboxes and their charge then pass through a continuous oven for baking. On emergence the cured cores or cakes are stripped and the hot boxes returned to the cycle. The cores, which have a top-half impression on one face and a bottom-half impression on the other, are then assembled with tie-bars and bottom and top closing cakes and runner box in suitable manner for pouring. A stack of castings so produced is shown in the illustration at the head of this account (Fig. 1).

* Patent applied for.

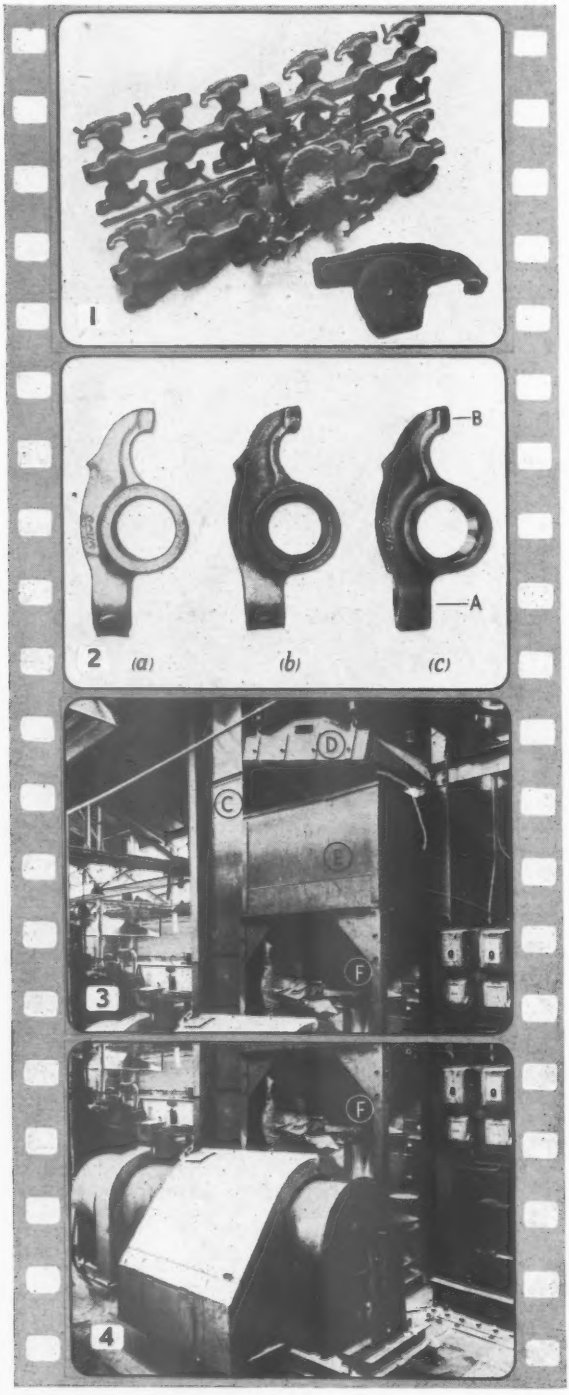
Rocker-arm Production

As mentioned in the introduction, the detail of compaction process for rocker-arm production as compared with the earlier method can well be considered in the manner of a film strip and this analogy is preserved in what follows:—

Frame 1. (Overleaf.) *Previous method.*—Here is shown a single rocker-arm casting (annealed, but unmachined) and a spray of castings produced from a green-sand two-part mould. The rather poor finish is apparent, relevant details for productivity being given in Table I. Prior to the introduction of compaction moulding, such moulds were made on a pair of Nicholls moulding machines at a rate of 600 moulds per day with a labour complement of 11 men.

Frame 2. *Compaction-moulded castings.*—The three castings shown (*a*) as cast, (*b*) as annealed and (*c*) machined, are for the same purpose as that in *Frame* 1, but made by the compaction method. Comparative production data are given in Table I. The metal employed is a pearlitic malleable of the following percentage composition: T.C. 2.2 to 2.4, Si 0.85 to 1.10, Mn 0.25 to 0.50 and copper 1.0 to 1.25.

The annealing cycle, carried out in a pit-type, radiant-heat tube furnace, fired by gas, consists of



bright annealing the components for six hours at 950 deg. C., followed by cooling to 745-750 deg. C., holding for three hours, cooling 540 deg. C., then discharging and air cooling. The total cycle takes about 16 hours and leaves the rockers at a Brinell hardness of 201 to 255. The annealing-furnace atmosphere is generated at 100 cub. ft. per hour and controlled to a percentage composition of: CO_2, 0.2 max., CO, 17.5 to 20.0, H_2 50 to 55, CH_4 0.2 to 1.0 and N balance. The final metal has, typically, a yield point of 20.3 tons per sq. in., ultimate tensile of 29.0 tons per sq. in.; elongation of 2.5 per cent. on 2 in. and a structure of temper graphite in a ground mass of lamellar pearlite. However, tests are now proceding to replace this material with a high-strength alloy cast iron.

Operations employed subsequent to annealing to produce the machined component shown at (*c*) include drilling and tapping the small hole at A, broaching the large hole; milling the pad at B, and final induction hardening the pad to the requisite degree.

TABLE I.—*Comparative Data for Rocker-arm Production Green-sand and Compaction moulded*.*

	Green-sand Moulded.	Compaction Moulded.
Production:		
Castings per core	—	14 (two circles)
Number of layers	one	twenty
Approx. castings per day ..	14,400	7,000
Fettled weight per casting ..	0.325 lb.	0.288 lb.
Poured weight per cast ..	26 lb.	111 lb.
Casting yield, per cent. ..	30	76

* For each day's production of compaction-moulded rocker-arm castings, five men are employed, inclusive of moulding, assembly and casting, but not metal melting. For the green-sand moulds, 11 men were employed to give the same equivalent output.

Frames 3 *and* 4. *Sand Selection and Preparation.*—A fairly pure variety of silica sand having an A.F.S. fineness number of 130 is first dried out in the small rotary gas-fired drier shown in *Frame* 4. The output of 20 cwts. per hour is more than adequate for the requirements of compaction moulding to date. The dried sand is then taken (*Frame* 3) by way of a vertical bucket-type elevator C, and a gyratory inclined sieve D, of 30 mesh, to a storage hopper E, being subsequently discharged as required from a dispenser F, which delivers 96½ lb.

Frame 5. *Sand Mixing.* The charge of cool sand (96½ lb.) is delivered to a modified resin/sand mixing machine G, a special lining and scraper having been fitted. Here, 3½ lb. (*i.e.* 3½ per cent.) phenolformaldehyde shell-moulding-type resin is added and mixed for 5 min., no wetting agents being used. Next, the charge is given further mixing in the Rotocube mixer H, another 4 min. being allowed. Finally, the resin/sand

is discharged and loaded into the hopper above the spreader unit—to be shown subsequently.

Frame 6. *Coreboxes.*—The cast-iron top and bottom mating coreboxes shown in this illustration are themselves produced from shell-moulded individual master patterns having double contraction allowance. As can be seen, the boxes are substantially built, with a deep skirt, which resists warpage; each weighs about 80 lb. The sprays of patterns are arranged in two circles of seven on either side of a central downgate, each impression having a single ingate; the parting line divides each rocker-arm symmetrically. In addition to the coreboxes shown, other coreboxes are required respectively for the runner-bar at the base; bottom and top cores of the assembly (each with one plane face), and for the top runner core, the last named being made in ordinary core-sand. The mould components produced from these are shown in *Frame* 13.

Frame 7. *Corebox Preparation.*—Before being fed into the continuous production cycle of compaction coremaking, each corebox is preheated to 200 deg. C. Thereafter, it is maintained at about this temperature throughout the working period as a result of transit through the cycle of operations, including a period of about two minutes in passing through the wire-conveyor-type curing oven. Movement outside the oven is on roller track, roughly comprising three sides of a rectangle, the continuous oven making the fourth side. At the inception of the cycle, the coreboxes are fed into an automatic spray-booth where their working surfaces are treated with a 2½ per cent. aqueous emulsion of a silicone release agent. *Frame* 7 shows the half corebox entering the booth; in doing so, the depression of roller I, actuates a lever mechanism which operates the internal spray. In the background (*Frame* 7) is the casing of the continuous oven.

Frames 8 *and* 9. *Dispensing Unit.*—As mentioned earlier, an essential feature of compaction moulding is the spreading of the correct amount of resin/sand into the heated corebox and arranging an excess of about ⅛ in. above the top of the box and yet not permitting fouling of the closing faces. This is done by the dispenser unit shown in *Frame* 8. First of all, a cast-aluminium mask or stencil place, N, ⅛ in. thick, is placed on the top of the bottom corebox after it emerges from the spray booth; this effectively measures and confines the ⅛ in. excess sand and shields the closing faces. The assembly is then placed on the leading edge of a short belt conveyor to take it beneath the dispenser. The latter consists of a hopper J, for the mixed resin/sand which by gravity automatically charges a delivery box,

K, with 4 lb. of the mixture, a window, L, giving visual indication. As the belt conveyor feeds the corebox and stencil beneath this delivery box at controlled speed, raised skids on the sides of the stencil engage with rockers and levers on the delivery box and open its discharge gate, so spreading the charge of sand in the corebox. Simultaneously, the doors from the main hopper are closed. At the conclusion of the passing of the corebox and stencil, these doors reopen and the delivery box is automatically re-charged with resin/sand. *Frame* 9 shows a close-up view of the dispenser unit and sand spreader. The arrangement also serves as a strickle plate to prevent waste; the small amount of excess sand falls through and is returned to the main hopper. The time of spreading now occupies about 15 sec., but the process can be so speeded as to fill six coreboxes of this size per minute; at present 110 cores per hour are made.

Frame 10. *Compaction.*—The filled bottom-half corebox then passes to the compaction press situated at the opposite end of the short belt conveyor. Here, the top-half corebox, which has been heated and sprayed, but has by-passed the spreader unit, is mated with the top half and placed under the flat platen of the Mills press. Matching of the coreboxes is by two dowel pins—of different diameters to prevent mismatch—permanently fixed in the top-half. In *Frame* 10, the squeeze pressure of 6½ tons is shown being applied; this is equivalent to 120 lb. per sq. in. of sand area. The load is retained for 10 sec.

Frame 11. *Curing and Stripping.*—After squeezing, the corebox assembly is passed through the tunnel-type electric oven on the wire-mesh conveyor, a process occupying 2 min. During the period in the oven, which runs at a temperature of 600 deg. C., the resin/sand core is cured and the coreboxes pick up about 40 deg. C.—roughly the amount they lose during the rest of the cycle. On emergence from the oven (*Frame* 11), the assembly is transferred to the stripper mechanism, lugs on the bottom corebox, O, engaging beneath fixed, inverted-L-shaped slides on the surface plate, these preventing lifting of this box-part. By a hydraulic mechanism below the surface plate, four lifting pins, P, two at each end of the box, are raised, engaging with lugs on the top half-corebox, Q, and stripping it from the core, R. The operator then takes off this corebox, blows it out and returns it to the production cycle. The core stays in the bottom-half corebox at this stage, because there is more draft and less depth in the top-half box. However, continuing movement of the hydraulic mechanism from below brings into operation and raises two annular-ring ejectors, and these effectively strip the core

from the bottom-half box by engaging with two rings of spring-loaded stripper pins built into the underside of the corebox (one pin per rocker-arm boss).

Frame 12 *Core Storage and Trimming.*—The stripped core is placed for cooling on one of a series of strip tables and the bottom-half corebox, like the top-half, is passed again to the automatic spray booth at the beginning of a new cycle. Before assembly into moulds, the cores are blown out and any fins removed from the edges.

Frame 13. *Mould Components.*—This illustration shows the various components which go to make up a stack mould for rocker arms, including the mechanical fastening plates and tie-bars:—

Required for One Stack Mould:

One—steel base-plate (S).
One—base core (T).
Two—choke cores (U).
One—bottom core (V).
(Obverse and reverse.)
One—top core (W).
(Obverse and reverse.)
20—body cores (X).
One—cast top-plate (Y).
One—runner core (Z).

Cores T, V, and W, are made in the same manner as the body core, X, the making of which has been described; in fact, cores V and W differ from X only in that one face is plain. The base core, T, carries the runner impression leading from the central downgate of the stack mould on either side so as to up-gate the two sprays of casting in each layer. In each half of the runner, a choke core, U, is inserted.

Frame 14. *Stack-mould assembly.*—Here, a number of finished built-up stacks of moulds are shown awaiting pouring, with a spray of 280 rocker-arm castings from one such mould in the centre. The method of assembly follows logically on the component grouping shown in *Frame* 13, each core locating on its fellow. Between the top core, W, and the runner core, Z, there is inserted a piece of ordinary brown paper with the object of choking back the rising metal in the up-gates when pouring, and so avoiding splashing and turbulence.

Frame 15. *Pouring.*—Another purpose for the paper insert between the runner core and the top core is to prevent dirt from entering the moulds while transporting the assembly to the casting point—at present some considerable distance away. Metal for pouring these rocker-arm moulds is specially melted in a 1-ton capacity electric-arc unit, starting with an all-cold charge. When the day's moulds have been assembled, as shown in the illustration, pouring begins as soon as the metal has been passed by the laboratory staff as being correct to the composition

Ford Compaction Moulding

desired. Casting temperature, too, is closely supervised during pouring. As is shown, the moulds burst into flames immediately and preserve their form only long enough for the castings to solidify. In half-an-hour's time after pouring, all that remains of the assemblies are stacks of castings standing cleanly each in a heap of decrepitated mould material.

Frame 16. *Exhibition Set-up.*—At the recent Production Engineering Exhibition, to illustrate the compaction process, the Ford company arranged the moulds and components shown in this illustration. Here, on the left-hand side, is a part-solid, part-sectioned *cast* mould revealing clearly which is metal and which sand; on the right is a stack of rocker-arm castings and in the foreground (centre) the old green-sand moulded spray; individual compacted cores have been placed on either side to accentuate the contrast between the methods.

In conclusion, the writer wishes to record his thanks to the Ford Motor Company, Limited, and friends on the staff for generous help given in preparing and illustrating this account.

Sheepbridge Development

Sheepbridge Engineering, Limited, Chesterfield, parent company of the Sheepbridge Group, have announced a change of name of one of their subsidiary companies. Sheepbridge Steel Castings, Limited, of Sutton-in-Ashfield, Notts, now becomes Sheepbridge Alloy Castings, Limited. An entirely new bronze foundry is being developed at Sutton for the production of special non-ferrous alloys. Another new development is the production of long-length tubes centrifugally cast in special metals. Long tubes of this type in single or bi-metal form have never before been available to British industry on an economic basis. By means of a patented process, the Sutton plant will make, in long lengths, centri-cast pipes and tubes in low- or high-alloy steels of the stainless or heat-resisting types; or, for example, piping consisting of a mild-steel exterior lined with a stainless-steel interior, or conversely a mild-steel pipe with an exterior surface of heat-resisting steel. The range of application of this new Sheepbridge development extends from large cylinder-liners for marine Diesel engines to stainless-steel radiant tubes for the furnace industry. The ability, by the new process, to produce bi-metal or composite tubes, often enables a physical structure to be created having characteristics impossible to reproduce in a single metal alloy by known metallurgical processes, thereby giving the design engineer, in effect, the advantage of an added range of metals.

Settlements

"We have recovered through our solicitors during the month ended June 26, 1954, the sum of £18,757 15s. 0d., and have rendered advice on the various aspects of the National Insurance Acts.

"The settlements listed refer to damages and are, with a few exceptions, reached without going into Court, and we acknowledge letters of appreciation from the members concerned or through the branch secretary."

Industrial Injuries and Legal Defence

The following is reprinted by permission from the *Foundry Workers Journal*, the official organ of the Amalgamated Union of Foundry Workers:—

Rule 35

"We regret that once again the attention of branch officers in particular, and members in general, has to be directed to this Rule. Legal aid is a benefit which carries with it the same obligation as any other benefit in the rule book.

"Clause 1 lays it down very clearly that subject to the member being entitled to legal aid under these rules, the National Council shall instruct the Union's solicitors to investigate the circumstances of the accident, and as soon as these investigations commence Union funds can be expended out of all proportion to any amount which an individual can pay in contributions, even although he may have a clear card during the whole period of his working life.

"Therefore, we have to ask ourselves the question. "Are we doing the right thing by the membership in general when we let our sympathy for an injured member get the better of us by asking the National Council to do something which they have no right to do under the Rules of the Union?

"We take second place to no organization in protecting our members' interests in so far as accidents are concerned. Our solicitors have definite instructions that expense is a secondary consideration when it is necessary to secure an expert opinion on the circumstances surrounding an accident.

"Our members, however, could considerably speed up investigations if they would pay a little closer attention to the questions asked on Legal Defence Schedules Nos. 2 and 3. The employer is not liable to pay damages when a member burns his foot or sustains an injury unless it can be established that there has been negligence or a breach of one of the statutory duties within the Factories Acts. Ordinary accidents which can happen without anyone being responsible are covered by the benefits provided within the Industrial Injuries Act.

"We suggest that when an accident happens, if it is felt the circumstances are such that the employer can be held to be liable to pay damages, then application should be made to the branch secretary for a Legal Defence Form No. 2. All questions should be answered and the way in which the accident occurred should be described as fully as possible in the member's own way.

It is very important that the member should state whether or not he feels the employer or some other individual was responsible for his accident, and his reason for any allegation he makes against the employer.

"The Schedule must be returned to the branch secretary, who will enter any arrears of contributions, impress the form with the branch stamp, sign it and forward to General Office. If this procedure is not carried out we shall have no other alternative than to return the Schedule to the member's branch intimating that no action is being taken.

"In conclusion, might we appeal for a fuller appreciation of the services which are at the disposal of our members who, through their elected representatives, are responsible for the rules of an organization which is doing so much to improve the working conditions of all foundry workers.

(*Continued at foot of Col.* 1.)

Notes from the Branches

Australia (Victoria)

At the July meeting of the Australian (Victoria) branch of the Institute of British Foundrymen, Mr. M. Barfoot gave a lecture on coreblowing, in which he drew upon experience gained in the employ of Ruston & Hornsby, Limited.

Scottish—North-Eastern Section

The final meeting of the last session of the North Eastern section of the Scottish branch of the Institute of British Foundrymen was held at the Imperial Hotel, Arbroath,, with the president, Mr. H. J. M. Conacher, in the chair. Before the speaker for the evening was introduced, the annual business of the section was dealt with. First, the secretary submitted his report, which showed that the past year had been a disappointing one. The attendance at meetings had decreased considerably and difficulties had also been experienced in obtaining speakers. The scattered nature of the membership and the position of Arbroath in relation to the centres of the foundry industry were factors contributing constantly to the section's problems. Therefore, it was up to the members to give their loyal, active support, as the success or otherwise of the Institute in this corner of Scotland was in their hands. This report and the financial statement were then adopted by the meeting.

In moving the recommendations of the Council concerning the office bearers for 1954-55, Mr. J. F. Webster said that the section would feel the absence of Mr. C. Scarcliffe, who would have become next year's president, but who had recently left the district. He voiced the feelings of all in wishing Mr. Scarcliffe every success in his new post. The following recommendations were seconded by Mr. K. Macnaughton and accepted by the meeting:—As *president,* Mr. D. Whyte; as *vice-president,* Mr. J. Mitchell; as *members of Council* (for two years), Mr. W. Calder and Mr. R. Sandilands, and (for one year), Mr. J. Matchett and Mr. G. Shepherd; *hon. secretary,* Mr. R. Leeks.

Mr. W. T. Watt then presented his paper, " Recent Trends in Foundry Practice." In this well-delivered and excellently illustrated contribution, Mr. Watt first described the layout and operation of a modern non-ferrous foundry, and finally his experiences in producing shell-moulded castings. During the discussion following, the president thanked Mr. Watt for his lucid presentation of a practical and stimulating paper. In his closing remarks, Mr. Conacher expressed a vote of thanks to the section secretary for his work during the year. He also thanked the directors of Urquhart, Lindsay, and Robertson, Orchard Limited, Mr. Fraser, Mr. Porteous and Mr. Crawford for their co-operation and assistance.

South Africa

The annual general meeting and dinner of the South African branch of the Institute of British Foundrymen was held in the Hotel Victoria, Johannesburg, on June 18, when 117 members and guests were present. The latter included Mr. F. C. Williams, advisory secretary of the Steel and Engineering Industries Federation, Mr. D. Lion-Cachet, a past-president, Mr. J. Tonge, past-president. Mr. W. C. Isaac, vice-president of the Institution of Mechanical Engineers, Mr. W. G. Gillespie, president of the Institution of Production Engineers (S.A.), Mr. J. Ritchie, director of the S.A. Bureau of Standards, Mr. W. T. Lund, health officer of S.A. Railways and Harbours, and Mr. A. Kukla.

Annual Report

After the adoption of the minutes of the last annual general meeting and of the balance sheet and accounts, the retiring president, Mr. H. J. G. Goyns, presented his Report on the year's activities from which the following has been abstracted:—

The composition of the branch Council was as follows:—

Mr. H. J. G. Goyns (president); Mr. J. A. de Kiewiet (senior vice-president); Mr. J. Steele (junior vice-president); Mr. G. Godfrey, Mr. A. A. Guest, Mr. K. H. Coombs, Mr. J. H. Peers, Mr. S. Pienaar, Mr. G. F. Alexander, Mr. A. R. Cluett, Mr. H. Hughes, and Mr. L. Hankart.

During the period under review the Council met on 11 occasions and was privileged to have the support of the following past-presidents: Mr. P. L. Ward, Mr. H. Holdsworth, Mr. W. C. Simpson, Mr. S. Jane, Mr. J. J. Marais, Mr. H. A. Godwin.

Membership of the South African branch was as follows:

Hon. life members	2
Members	87
Associate members	82
Associates	28
Subscribing firms	43
Representatives	31
Total	273

During the year, ten applications for membership, one transfer from associate to member, and one from associate member to member, were approved, and two members resigned. By arrangement with head office of the Institute, the records of the Cape Town section were transferred to Johannesburg.

Bearing in mind the wide field which was served by the Institute, the growth of the industry, and the extent to which foundry personnel were eligible for membership, it was a matter of regret that more individuals did not take advantage of the benefits to be gained therefrom. It was, however, pleasing to note that, due to the efforts of a few enthusiasts, an increased number of applications had been received in recent months from the East Rand.

During the year, 11 papers and one film evening were arranged. The papers presented were of a high standard and covered a range of subjects of importance to the South African foundryman. The manner in which members attended and took part in the discussions was a source of considerable satisfaction to the branch Council and the authors, especially when one considers the months of hard work and careful preparation involved in compiling papers of the quality now demanded. To the gentlemen who had given so willingly of their time, knowledge and experience in preparing these papers, the Council was deeply grateful, and it was hoped that the enthusiastic manner in which the members had responded was, in some small measure, a recognition of the great value placed upon their efforts.

During the session visits were arranged to: (1) the Klip power station, (2) the S.A.B.C., (3) Scaw Alloys Limited, (4) African Metals Corporation Limited. Those excursions were an undoubted success, and the opportunity thus provided to discuss, in a frank and open manner, the methods and equipment employed in the various factories, spoke well for the enlightened attitude of the managements concerned and to them he offered grateful thanks.

Technical Committees

The parent body of the Institute, since its inception, had formed a total of over 40 technical sub-committees to report on metallurgical, technical and practical

Notes from the Branches

subjects of importance to foundrymen. Nevertheless, there were a number of factors peculiar to South African conditions, which had not been covered by the overseas investigations. With this in mind, the initial steps had been taken to extend the scope of activities by forming two technical sub-committees whose terms of reference embraced considerations which were purely South African.

The first sub-committee was investigating the position regarding the quality of South African foundry coke. To this end, Dr. Petrick and members of the Fuel Research Institute were co-operating with several prominent foundrymen versed in the metallurgical, physical and mechanical requirements of cupola coke.

The second sub-committee was charged with the methodical examination of known deposits of sands, suitable and available for use in South African foundries. In this connection, the branch's vice-president, Mr. John de Kiewiet, during his present stay in America, was obtaining information on which it was proposed to base the sampling and test procedures to be adopted.

In establishing these technical sub-committees and outlining the preliminary programmes, the Council has been privileged to receive encouragement and assistance from similar bodies overseas. It was early to predict the outcome of these activities, but ultimately they could only prove of benefit to the South African foundrymen in general. The departure of Mr. P. L. Ward—who left for Canada some months ago—had left an undoubted gap in the ranks, and he took the opportunity to record an appreciation of his valuable work during his long association with the branch.

Thanks were also due to the secretaries who carried out, in their usual efficient and praiseworthy manner, the considerable work involved in running affairs.

As mentioned previously, the senior vice-president, Mr. John de Kiewiet, was on a visit to America, and due to his extended absence it had been decided to make certain alterations in the constitution of the Council for the coming year. The branch Council would therefore include the following: president, Mr. J. Steele; senior vice-president, Mr. J. A. de Kiewiet; junior vice-president, Mr. G. F. Alexander. The four vacancies on the Council had been filled by the re-election of the three retiring members: Mr. G. Godfrey, Mr. A. A. Guest and Mr. S. Pienaar, and the appointment of Mr. J. Ferguson as a new member.

Mr. Goyns then delivered his valedictory address which was followed by a presidential address from Mr. Steele.

After the adoption of the report of the branch Council, the retiring president called upon Mr. S. Jane to present the members' papers' award to Mr. L. Hankart and A. Korver and the hon. members' award to Mr. A. Kukla. Students receiving awards were Mr. C. F. Gunter, Mr. G. R. Frederickson and Mr. J. F. van der Poll.

The proceedings concluded with addresses from Mr. Tonge, Mr. Lion-Cachet and Mr. F. C. Williams.

New President

The newly-elected president of the South African branch, Mr. John Steele, started his training in the Clyde Alloy Steel Company, Scotland, and was later employed as a moulder in the iron and non-ferrous foundries of G. & J. Weir. He went to South Africa in 1947, moving from Durban to take up a post in the foundry laboratory of I.S.C.O.R. He took up his present position as foundry manager in the Precision Casting Department of Rely Products in 1949, where the Shaw process of precision casting is used.

New Catalogues

Spray Gun. A leaflet (CB 109) received from B.E.N. Patents Limited, High Wycombe, Bucks., illustrates and describes the mechanical details of an internal atomizing spraying gun. It is available to readers on writing to the High Wycombe address.

Centralized Lubrication. A system of centralized lubrication is lucidly explained in an eight-page catalogue just issued by Tanway, Limited, Barnby Dun, Doncaster. By the system, oil or grease is metered out to the points requiring lubrication. It is available on application to Barnby Dun.

Pumps for Handling Abrasive Solids. The Wilkinson Rubber Linatex, Limited, Camberley, Surrey, have issued a well-illustrated, 16-page catalogue, which covers the subject of incorporating rubber in the construction of pumps handling abrasive material in suspensions or corrosive liquors. For readers who encounter such problems, this brochure is available on writing to Camberley.

Gas Infra-red Radiant Heaters.—A leaflet received from the Harris Engineering Company Limited, Browning Street, London, S.E.17, reminded the reviewer that many years ago in the first mechanized automobile foundry he ever visited, one of the core-drying stoves was heated by means of town's gas passed through porous plates. Now from this leaflet, the system has been perfected for shop heating. The burner known as the Schwank type, can use either town's gas, liquid gas, or petrol gas, all being under differing pressures. The system is generally hung from above and throws the heat downwards. This interesting leaflet is available to readers who write to Browning Street.

Overhead Handling Equipment. Productivity teams reporting on American handling facilities commented favourably on the monorails serving the foundry industry. There is thus much of interest in a new catalogue just issued by British Mono Rail, Limited, Wren Works, Chadderton, Lancs, as they are associated with the American Mono Rail Company. The catalogue, noteworthy for a particularly attractive emblem on the front cover, deals logically, with ample illustration, with each component used in the construction, including such items as switches and turntables. Underslung cranes, both manual and electrified, are included. This very interesting catalogue is available on application to Wren Works.

Steel Castings. Quite a novel and interesting lay-out has been used by Bonnington Castings, Limited, Bonnington Road, Edinburgh, in a recently-issued brochure covering repetition steel castings. It is bound with a spiral, and wherever the book be opened there is a decorative half leaf which indicates an industrial consumer, and opposite to it, appropriately illustrated, an account of the services available. The reviewer has never personally inspected the foundry, but from the illustrations it has every appearance of being well equipped. He has only one suggestion to make, and that is the picture of the fettling shop, better use could be made of equipment to prevent accumulations of small castings on the floor. Beyond this small criticism the reviewer has nothing but praise, as the publication does credit to the foundry industry.

AN EXTENSION to the factory of Rapid Magnetic Machines, Limited, Birmingham, has commenced and should be completed in six months time.

"Warm" Blast for Cupolas

Worthwhile Advantages expected from Modest Installation

The recent publication of results obtained with hot-blast cupolas in Great Britain[1] has shown that very considerable savings can be achieved by the installation of a recuperative unit which will preheat the blast to 450 to 500 deg. C. and that even a separately-fired air-heater can be justified in some cases. As, however, the capital cost of the plant is high, it is difficult to see a satisfactory return for the investment unless the cupola plant works for about eight hours daily. Under these conditions it is usually possible to show that the capital investment is recovered within two years' working.

Short Melts

There are, however, many foundries where an afternoon melt of from two to four hours is the rule, and here the installation of a "hot"-blast, recuperative unit cannot be justified on financial savings alone, although there will be many technical advantages such as higher tapping temperatures, lower sulphur content iron, etc., which are difficult to assess in terms of money. These short-melting-cycle foundries are, therefore, largely unable to make use of the undoubted advantages that hot blast can bring.

The high capital cost of the recuperative plant for "hot"-blast temperatures of 450 to 500 deg. C. results from the necessity to use heat-resisting materials in the manufacture of the recuperator and in the construction of the insulated gas-system, complete with heat-resisting changeover valves, etc., for withdrawing the cupola gas from the cupola. Another costly item is the instrumentation necessary to control the blast temperature at a steady figure while receiving a varying heat input from the cupolas, such variation being due to shut-downs, uneven working, bridging, slagging off, etc. On the other hand, there has been evidence[2] from some of the "hot"-blast plants when run at lower temperature that temperatures of about 250 deg. C. ("warm" blast) can bring considerable benefits. Few quantitative figures are available but the following advantages are expected:— (1) Coke savings of 15 to 20 per cent.; (2) slightly increased carbon pick-up; (3) higher tapping temperatures—especially initially; (4) iron of lower sulphur, due to the lower coke consumption.

Reduced silicon and manganese losses realized within the hot-blast cupola, and which play a large part in its economy, cannot be expected with the "warm"-blast cupola. However, the advantages outlined above suggest that some charge economies could be made, apart from the coke saving, by making use of the lower sulphur pick-up—for instance, by charging more scrap. In many foundries the addition of more bought-in scrap, or even back-scrap, is limited only by fear of the sulphur content of the iron rising above the desired limit.

Separate Air-heater

To meet the need, therefore, for a low-cost, "warm"-blast cupola installation, a separately-fired air-heater has been devised with a thermal efficiency of 80 per cent. which will heat the blast to 250 deg. C. By the use of separate firing, the expensive gas take-off system has been avoided, together with much of the instrumentation, and as the efficiency is so high, little advantage is lost by abandoning the recuperative cycle.

The principle[3] of the "warm"-blast stoves is shown in Fig. 1, whereby it will be seen that the products of combustion from the coke pass through tubes round which the air is passing. In addition, the air finally passes round the combustion space itself and is delivered at the bottom of the stove at 250 deg. C. Chains hang down the centre of each tube to increase the heat transfer and also to provide a means of removing any coke ash adhering to the inner tube surface by rattling them with the handle provided on the upper casing. The stove illustrated is fired with coke but gas or oil fuel can be used by replacing the plate carrying the charging door with a suitable mounting for a gas burner, for instance, as shown in Fig. 2.

The dimensions of three sizes of stoves are given in Table I, from which it will be seen that they are very compact and could be fitted in without difficulty into the most crowded foundry. From the same table it will be seen that the pressure loss of the air is low so that the same fans, as used for cold blast, could be used with-

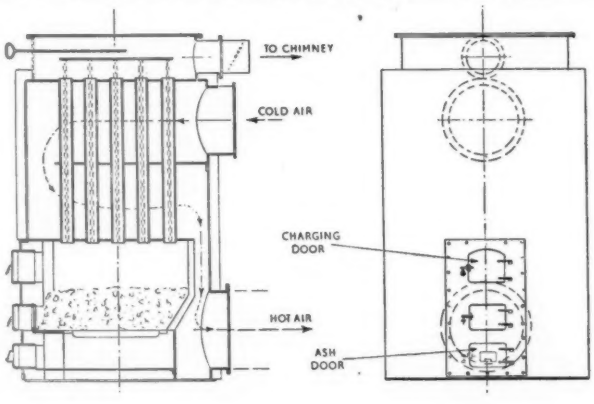


FIG. 1.—*Sectional and external views of the hot-air stove designed for coke-firing.*

TABLE I.—*" Warm " Blast Stoves Delivering Air at 250 deg. C.*

Cupola Melting rate, tons per hr.	Stove size.	Heat transferred, B.Th.U. per hr.	Vol. of air heated, cub. ft. per min.	Pressure loss on air side, in. W.G.	Coke consumption per hr. in lb. (c.v. = 11,700 B.Th.U. per lb.).	Height H in Fig. 2.	Dia. D in Fig. 2.
1½	L.10.H	300,000	590	2.0	31	7 ft. 9 in.	3 ft. 7 in.
2½	L.20.H	600,000	1,180	2.0	61	8 ft. 4 in.	4 ft. 2 in.
3½	L.30.H	900,000	1,650	2.0	80	13 ft. 3 in.	4 ft. 9 in.

out difficulty, although it is recommended that a pressure of 15 to 20 in. w.g. minimum at the tuyeres is used.

For coke firing of the stove, the combustion air is split internally off the cupola blast stream, so that no separate combustion air fan is needed. To fit such a stove into an existing cupola plant, it is only necessary to place the heater on its foundation, break the existing blast line and connect in the heater. For gas- and oil-fired stoves, it is necessary, in addition, to pipe the fuel to the stove and tap off combustion air from the existing blast line. Table I also shows the fuel consumption of the stoves when coke fired. Due to the high thermal efficiency of 80 per cent., the consumption is low and little attention is necessary to the stove for short cupola blows after the initial lighting up and charging. From these consumption figures it is also possible to study the economy of " warm " blast.

Economies

With " warm " blast at 250 deg. C. it will be possible to effect an economy of about 20 per cent. of the cupola charge coke. If the cold-blast coke consumption is 15 per cent. charge coke (6.7 : 1) this will result in a saving of about 68 lb. of coke per ton of iron melted, or 170 lb. per hour for a 2½ tons per hour cupola. The consumption of the " warm ". blast heater for a 2½ tons per hour cupola is 61 lb. and there will be, therefore, a saving on the weight of coke and, in addition, the heater can be run on ordinary gas-works coke and does not need high-quality foundry coke. The heater consumption figures given are for the heater when running; higher overall figures may be expected to allow for starting up, shutting down, etc., but even so there will be a substantial saving on coke alone. The savings effected by higher tapping temperatures, lower sulphur contents, increased carbon pick-up, etc., will be supplementary to the coke saving. Installation is simple, as already outlined, and the capital cost low, probably only a quarter of that of a recuperative type of plant delivering " hot " blast at 450 to 500 deg. C. Warm-blast cupolas should, therefore, be an economic proposition to the short-melting-cycle founder who blows only in the afternoon or even one or two days a week.

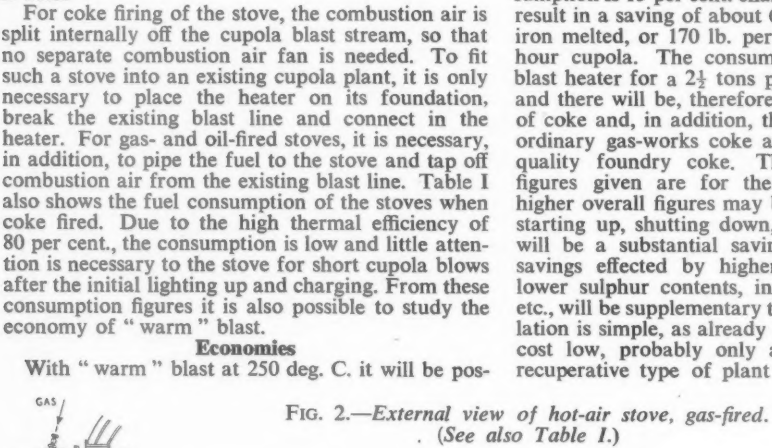


FIG. 2.—*External view of hot-air stove, gas-fired. (See also Table I.)*

REFERENCES

[1] Report of Sub-committee T.S. 43 of the Institute of British Foundrymen, FOUNDRY TRADE JOURNAL, July 8 and 15, 1954.

[2] "Operating Experiences with Hot-blast Cupolas in Great Britain." FOUNDRY TRADE JOURNAL, July 16 and 23, 1953.

[3] British Patent No. 709716 (Metallurgical Engineers, Limited).

Publications Received

" D" Process for Precision Castings; issued by the Harry W. Dietert Company, 9330, Roselawn Avenue, Detroit, Michigan.

This 17-page mimeographed report should be read in conjunction with the Paper presented by Mr. Dietert to the Glasgow Conference or the Institute of British Foundrymen (printed elsewhere in this issue), as considerable activity is being exhibited at the present time in blowing shell moulds with sand bonded with resins. It is this development which would seem to be of major interest. Mechanical clamping is easy to devise, and three methods are illustrated. Eleven advantages are set out for precision castings and one not usually seen is No. 3—" they offer a means of materially reducing the dust problem in the foundry." Three problems capable of worrying the founder of precision castings are set out, and amongst these is one worth emphasizing, namely, that owing to rapid development, equipment bought to-day may rapidly become obsolete, and the motto *va piano* is worth following. The brochure is available to readers on writing to Detroit.

Symposium on Aluminium in Building. Published by the Aluminium Development Association, 33, Grosvenor Street, London, W.1; price 4s.

From a perusal of this very interesting publication, there seems to be little place for aluminium castings in the building industry, except for decorative purposes. These applications are shown in several excellent illustrations.

"D" Process for Precision Castings*

By H. W. Dietert

A need for precision castings exists, not so much due to their nice appearance, as that they offer a means of reducing the number of machining operations. The cost of a part may be reduced by providing castings as near as possible ready to fit into a machine. It is profitable to make parts by the casting process that are nearly finished and require the least amount of additional labour to convert them into finished items. Such castings are worth considerably more than inaccurate castings and they will put into the foundry a greater monetary flow. This amounts to an increase in sales and production volume without necessitating plant space expansion.

Precision casting is needed in the foundry industry for it offers many advantages, some of which are worthy of being enumerated:—

1. Foundry operations such as cleaning, grinding, filing and salvage work can be reduced.
2. Precision casting moulds are generally much lighter than conventional moulds, thus permitting a reduction of manual effort.
3. Such moulds offer a means of materially reducing the dust problem in the foundry.
4. Precision-casting methods allow for easy, condensed mechanization.
5. The casting finish is greatly improved, thus making for greater casting appeal.
6. The weight of precision castings may be reduced by elimination of excessive allowance for machining.
7. The accurate casting contour of precision castings makes for better fit into jigs, fixtures and into chucks. This eliminates off-centre finished holes in the machined part.
8. Chucking operations may be speeded up, due to the more accurate contour.
9. There is lower tool breakage due to more accurate chucking.
10. Turning, broaching and boring operations may be eliminated by using only a grinding operation to finish the precision-cast surface to produce an accurate wear-resisting surface.
11. Allowance for turning, broaching and boring may be eliminated.

These attributes of precision castings may paint an irresistible picture to too many foundrymen. A foundryman has the right to ask the question, if a precision casting will do all of that, why wait and go slow? It is thus advisable to mention some of the problems facing the precision-casting founder:—

1. Precision casting methods are still in a stage of rapid development. Much money can be invested now in equipment which may be obsolete in a comparatively short time.
2. Precision-casting methods available at the present time are mainly for the small castings weighing, for example, under 25 lb. Several operations are in production where precision castings up to some 200 lb. are made which require very little working to finish the part. A foundry may be unable to find sufficient tonnage to pay for the necessary capital investment.
3. Much research work is still necessary to enable the foundry to hold tolerances on cast parts that are specified now or that will be specified in the future.

Basic Principle

The precision casting field requires of the foundrymen much in the way of accepting and learning new techniques. Fortunately, these new techniques follow the general teaching of the green- and dry-sand foundry. Three basic principles are in use in making present-day precision castings:—

(1) Use a mould of very high hardness which will support a molten-metal load without deformation.

(2) Use a moulding material of very fine grain that will give a fine, smooth finish.

(3) Use a mould material of controlled collapsibility and thermal volume.

The high mould hardness is obtained either by baking or firing the mould which contains bond or bonds that bake or fire hard. The fine-grain moulding material is either used as a relatively thin coat on the metal/mould interface or it is used throughout the depth of the mould. The permeability essential for venting the mould or mould face is secured due to the fact that the coat of fine material is thin. The thinner the coat the higher the permeability. Thin moulds of fine-grain structure possess ample permeability due to their thinness.

When an entire thick mould is made from a relatively fine grain material, the gas content of the moulding material must be kept at a minimum, so that a material of low permeability may be used. Moulding materials used in some precision casting methods are compounded to give a predetermined expansion/contraction upon heating. The rate at which the bond in the moulding material collapses at elevated temperature is often controlled. In shell moulds, the rate of collapsibility is retarded by choice of bonds or an additive.

Patterns

It is well to have an overall picture of the type of patterns used in the precision casting field. They may be catalogued as follow:—(1) Wax pattern; (2) frozen-mercury pattern; (3) hot, metal pattern; (4) cold, metal pattern; (5) rubber pattern; and (6) machined cavity.

Both the wax and frozen-mercury patterns allow for very intricate designs of the part since they are

* Paper presented at the fifty-first annual meeting of the Institute of British Foundrymen, held in Glasgow.

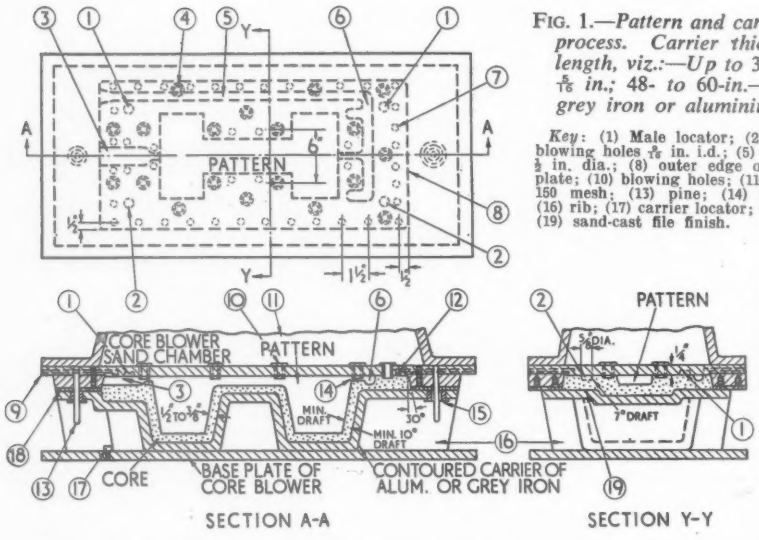


FIG. 1.—*Pattern and carrier assembly for the "D" process. Carrier thickness varies according to length, viz.:—Up to 36 in.—¼ in.; 36- to 48-in.—⅝ in.; 48- to 60-in.—⅜ in. (They are made in grey iron or aluminium.)*

Key: (1) Male locator; (2) female locator; (3) header; (4) blowing holes ⅛ in. i.d.; (5) sprue; (6) runner; (7) vent holes, ⅜ in. dia.; (8) outer edge of core; (9) pattern and blowing plate; (10) blowing holes; (11) sand; (12) vent holes, s.-s. cloth, 150 mesh; (13) pine; (14) ingate; (15) elongated bushing; (16) rib; (17) carrier locator; (18) machine or disc-grind carrier; (19) sand-cast file finish.

removed by heating the completed mould causing the pattern material to leave the mould cavity. These patterns are formed in accurately machined metal pattern moulds. The metal pattern whether used hot or cold is machined to an accuracy of ±0.001 in. and mounted on metal patternplate. Patterns made of rubber may be employed to form mould cavities with back draft. Moulds in which the pattern impression is machined in the mould are also in use.

Precision-casting Methods

As a foundation for a study of the "D" process, it is desirable briefly to review some of the general methods of making precision castings. The principal processes are:—(1) Investment; (2) shell moulding, "C" or "D"; (3) carbon mould "G"; (4) ceramic mould; (5) plaster-of-Paris mould; (6) precision dry-sand mould; and (7) high-pressure moulding.

The investment process, sometimes referred to as the lost-wax process, employs the principle of using a mould coating of very fine grain, backed up by a material having relatively high permeability. The pattern is of wax and is removed upon mould baking. The mould material is generally of a chosen thermal expansion. This process finds its greatest application in small precision castings of all metals. Many small castings are made in production lots with normal tolerance of 0.005 in. per in. and surface finish with 50 R.M.S.

The shell mould, whether it be made by the Croning or Dietert process, employs a metal pattern. The Croning ("C") process uses a hot pattern, while the Dietert ("D") process uses a cold pattern. Both processes employ the principle of obtaining a high permeability with a fine-grain silica sand by using a thin mould. It may be further stated that in the "C" process the shell is formed over the hot pattern by gravity flow of the sand and resin binder that softens on heating. The "D" process uses a coreblower to form the shell. The shell is baked in both processes and shells are held together with shot in the "C" process and with mechanical clamps in the case of the "D" process. Castings with a tolerance of 0.005 in. per in. of length are in production. Surface finishes down to 50 R.M.S. are possible in regular production.

The carbon-mould process may be designated as the "G" process in honour of the Griffin Car Wheel Company who developed this process to a high degree[1, 2]. In the "G" process, two permeable synthetic-carbon blocks are first machined for the pattern impression to form the mould. The mould cavity is coated with a silica-base wash after each casting, weighing 9 cwts. Steel car-wheel castings with a tolerance of 0.020 in. are in production. After making 150 castings, the mould is re-machined.

Precision casting moulds are also made of a fine ceramic grain bonded with a chemical. This process has been developed into a good production method by the Michigan Steel Casting Company and will be designated as the "M" method. The moulding material, as in the case of the investment process, is in the form of a slurry and is poured over a wax pattern. In the "M" process, the mould is fired at a low temperature, causing the wax to flow out of the mould cavity and set the chemical bond in the moulding material. This process finds good application in making intricate castings of highly-alloyed metal of a heavier type than those made in the investment process.

The plaster-of-Paris, precision-casting method employs a metal pattern over which a slurry of special plaster-of-Paris is poured. The mould is thick; and dried plaster moulds possess ample permeability. This method is used in production particularly for aluminium castings of good accuracy and finish. The usual precision casting tolerances are obtainable.

The precision dry-sand moulding method is one mainly employed by the American Brake Shoe Company for castings of a wide range of applications with exact surface contour and excellent finish. In this method, precision is applied in all phases of equipment and moulding of a dry-sand mould. The

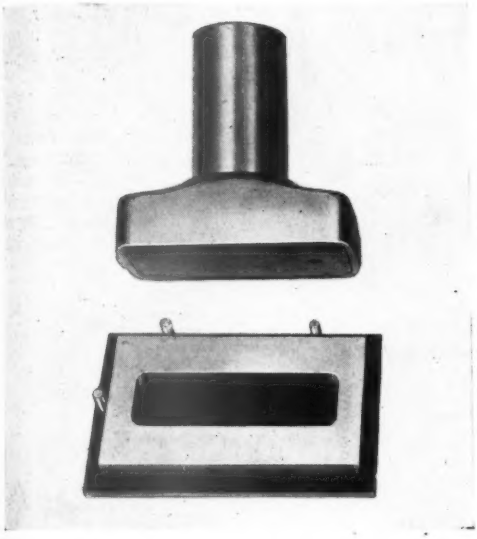


FIG. 2.—*Test corebox used to determine the "blowability" of corebinders.*

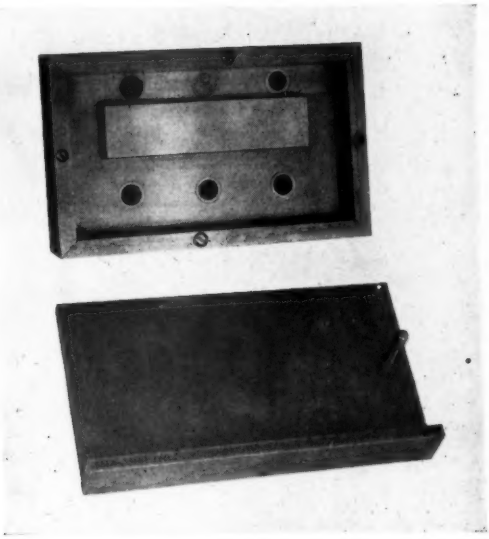


FIG. 3.—*Test corebox used for determining the stickiness of corebinders.*

application shows what can be done to perfect the usual foundry operations.

The high-pressure moulding system employs a cold metal pattern, strong flasks, and silica sand bonded with hydrocarbon resin and bentonite. Moulds are squeezed with pressures up to 450 lb. per sq. in. This method is under the guidance of Mr. Norman Dunbeck[3]. Both grey-iron and brass castings are produced on experimental runs. This method like other precision casting methods produces castings with much appeal.

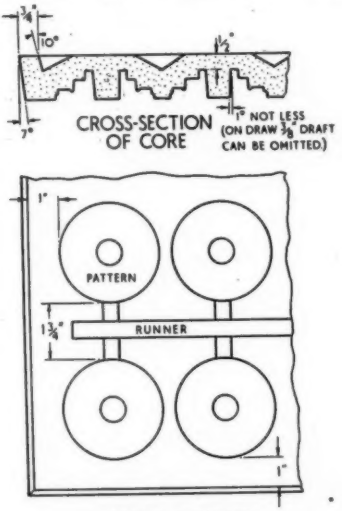
From this great variety of methods, sustained effort will surely resolve some very profitable precision-casting processes that will extend the range of foundry operations.

"D" Process, Historical

The Author started his intensive research work on the "D" process in 1952. The motivating force being the belief that a good shell mould could be blown with a conventional coreblower. If this were possible, a large selection of binders such as oil, resin and cereal could undoubtedly be developed that would produce shell moulds at low cost. The shell moulds are to be rapidly baked in conventional core ovens and, for casting, the shell mould would be held rigidly together by means of mechanical clamps. The latter is easy since the back of a blow "D"-process shell is smooth and hard.

Early in 1953, the Author asked and secured assistance from Mr. L. P. Robinson and Mr. O. J. Myers[4] in providing various binders for the experimental work. Shortly thereafter Mr. W. Ferrell[5] made the first runs of "D"-process moulds in his foundry, casting experimental automobile crankshafts. With the valuable aid received from these co-workers, it was definitely shown that the "D" process was practical and apparently had merit. During the latter part of 1953, Mr. John Ostergren[6] made pattern equipment and rigging for the "D" process to cast three different small compressor parts in iron. This pattern equipment went into production in the early part of 1954, producing several hundred thousands of precision castings.

FIG. 4.—*Pattern lay-out for the "D" process.*



PATTERN LAYOUT

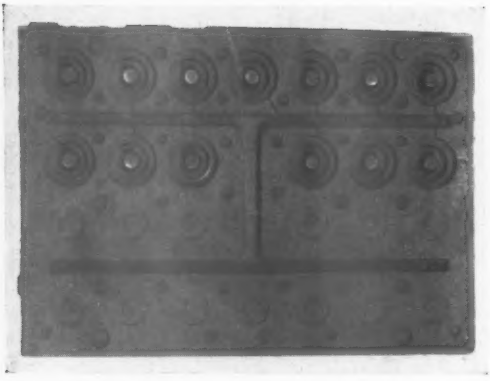


FIG. 5.—*" D "-process core containing both the cope and drag section on one plate.*

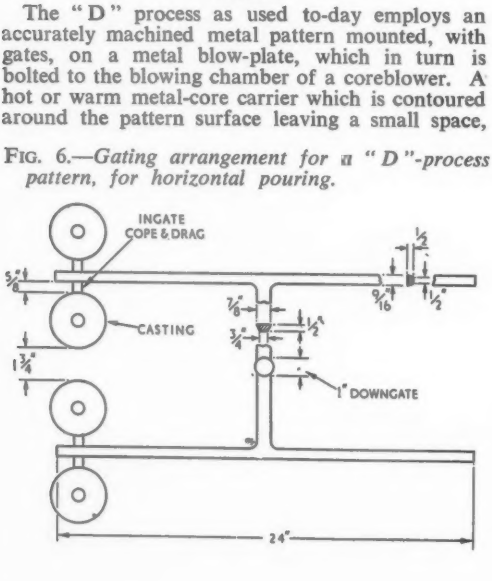
Another co-worker who has done a great deal of research on " D "-process binder is Mr. Wayne Buell[1]. Mr. Ferrell has his production equipment completed now for crankshafts and is going into production.

Patent applications covering the " D " process have been entered by the Author in the United States, United Kingdom, Germany, France and Italy. The plan is not to charge any foundry royalty, but to obtain a small royalty payment from manufacturers of binders made for the " D " process, with the hope that the large expenditures in time and money in developing the process would be repaid and such receipts would also help to pay for continued research on this or other processes which may further the casting industry.

Method

The " D " process as used to-day employs an accurately machined metal pattern mounted, with gates, on a metal blow-plate, which in turn is bolted to the blowing chamber of a coreblower. A hot or warm metal-core carrier which is contoured around the pattern surface leaving a small space, usually $\frac{1}{8}$ in. for the core sand is placed under the pattern (Fig. 1). The two are clamped together by the coreblower and the core-sand is blown through blowing holes in the patternplate into the space between the pattern and drier. The pattern is cold and the drier is hot. The carrier with the blow shell mould is then placed in the core oven and baked. The baked core is removed and two such cores are clamped together, forming a rigid mould. Moulds are poured either vertically or horizontally as chosen, allowed to cool from $\frac{1}{2}$ to 3 min. and then the casting is removed. The burnt sand may be reclaimed.

FIG. 6.—*Gating arrangement for a " D "-process pattern, for horizontal pouring.*



Suitable Sand

A fairly wide range of sand quality may be used for the " D " process, ranging from 90 to 150 A.F.S. fineness number. The clay content should be less than 0.3 per cent. A.F.S. clay substance. Either washed and dried sands, or bank sands, which are carefully graded to remove any coarse-grain and foreign material such as roots, leaves, etc., may be used. The fineness of some of the shell sands in use are recorded in Table I. The bank sand shown in Table I is a low-priced, dried and graded bank sand mined in Michigan. The price at the shipping point is 20s. per ton by the truckload; this material represents the lowest-priced shell sand, while others range up to about £4 per ton.

Binders*

At the present time, binders for " D "-process cores are mainly special core oils. One plant is using oil and dextrin. Some " D "-process cores have been made using a phenolic-resin bond, with a special liquid. Thus, bonds for " D "-process cores may be divided into three groups:—(1) " D "-process oil, without water; (2) " D "-process oil, plus cereal, plus water; and (3) resin, plus liquid.

The first group, using " D "-process oil without any water, utilizes a dry material to retard sticking. The dry sand and oil are mixed together in a conventional sand mixer for at least three minutes.

TABLE I.—*Fineness and Percentage Sieve Grading of some Sands for the " D " Process*

A.F.S. Fineness	133.3	124	123	115	153	95.8
Sieve No.	Illinois Sand.	New York Sand.	Penn. Sand.	Mich. Sand.	New York Sand.	O.K. Sand.
6	—	—	—	—	—	—
12	—	—	—	—	—	—
20	—	trace	—	—	—	—
30	trace	0.2	0.1	—	—	—
40	trace	0.4	trace	0.2	0.1	0.1
50	0.2	3.7	1.4	1.2	0.6	0.9
70	0.3	13.2	9.1	3.6	3.9	8.3
100	7.7	23.3	19.4	17.9	13.4	37.3
140	38.4	20.2	21.9	35.5	22.9	33.2
200	33.6	17.8	25.2	32.7	26.1	15.7
270	13.2	8.6	12.2	6.9	14.5	3.0
Pan	6.6	12.4	11.1	1.5	17.9	1.2
A.F.S. Clay, per cent.	0	0.2	0	0.5	0.6	0.3

[* During the discussion on this Paper at Glasgow, it was stated that since the Paper was prepared, the Author has modified his ideas on the subject of binders. This will be made clear in the report of the discussion, which is shortly to be published—EDITOR.]

FIG. 7.—*Gating arrangement for a crankshaft casting, with a bottom ingate for vertical pouring.*

Then a dry material is added which covers the oil layer around each sand grain with a dry coating. The core-sand mixture loses its oily and sticky feel, thus eliminating sticking tendency. Some formulæ for this type of mix are:—

"D"-process cores made with oil, cereal and water which are used successfully for casting gears may have the formula:

		Per cent.
A.	Shell bank sand	96.5
	"D"-process oil	2.0
	Naval stores resin	1.5
B.	Shell bank sand	97.5
	"D"-process oil	2.0
	Powdered hydrocarbon	0.5
C.	Shell bank sand	95.5
	"D"-process oil	2.5
	Fine, grade E, coal-dust	2.0
D.	Shell bank sand	91.5
	"D"-process oil	2.5
	Fly ash	6.0
E.	Shell bank sand	95.5
	"D"-process oil	2.5
	Iron oxide	2.0
		Per cent.
F.	Shell sand	98.0
	"D"-process oil	1.0
	Dextrin	1.0
	Water	2.5

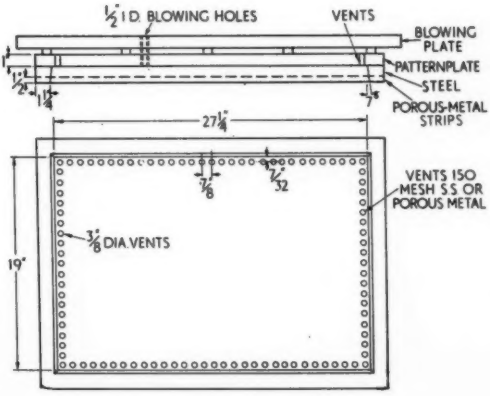
The mechanical properties of cores for the "D"-process shell are very important. First, the mixture must possess good blowing potential of at least 65 per cent., where "blowability" is expressed by the ratio of "green" hardness of a blown test core, Fig. 2, over "green" hardness of an A.F.S. rammed 2 in. by 2 in. core specimen. A high "blowability" value is necessary to permit one readily to blow a thin core.

A second mechanical property is minimum stickiness. Stickiness is measured by determining the number of cores that may be blown without any sand grains sticking to the surface of the test core-box (Fig. 3). At least 15 of the boxes shown can be blown before any single sand grain begins to adhere to the test core-box surface. The art of drying up the oil binder with a dry material such as fly ash, naval stores resin, coal-dust, powdered hydrocarbon resin or iron oxide has proved most helpful.

A third mechanical property that is necessary is adequate green-strength. The green-strength in a "D"-process core mix is largely obtained by compactness of the relatively fine-grain structure and the fine, dry material added, such as the naval stores resin. To obtain green-strength of the core in the carrier, it is necessary to obtain a firm blown core. A soft blown core has low green-strength. A heavy-bodied core-oil is a means of obtaining sufficient green-strength. However, such oils are slow in mixing and difficult to handle in cold weather. A green-strength from 0.5 to 0.7 lb. per sq. in. is readily obtained from sand mixtures A to D inclusive. The sand mixture, E, may be expected to give 0.40 lb. per sq. in. in green-strength. A green-strength in this range will usually be suitable for the general run of cores. The bench life should be at least three hours without excessive crust formation. An A.F.S. tensile core specimen, $\frac{1}{4}$ in. thick, when baked at 215 to 260 deg. C. in an A.F.S. specification core oven for 20 minutes, should produce a strength of at least 200 lb. per sq. in.

The binder, in case of oil, should be an all-drying oil and not compounded with oils or materials that will not add to the strength of the baked core. The baked tensile strength of a "D"-process core should be over 200 lb. per sq. in., with a dry-hardness of 90 plus. The mixture should be so compounded that the "D"-process shell will not

FIG. 8.—*Venting the perimeter and border frame of a patternplate.*



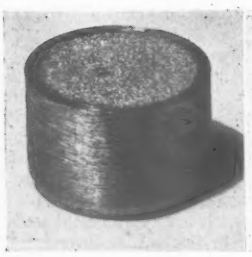


FIG. 9.—*Stainless-steel vent of 150-mesh material.*

FIG. 10.—*Powdered-metal vent.*

collapse before the casting is solidified. The rate of collapsibility of a "D"-process shell for a light casting with metal thickness averaging ½ in. should be about 400 sec. Cores for castings with sections of 2 in. should not collapse in under 10 min.

The collapsibility is measured on a test core 1½ in. dia. and 2 in. long, A.F.S. rammed, and baked the same as production cores, cooled and then inserted in the dilatometer at 1,080 deg. C. First, a load of 50 lb. per sq. in. should be applied on the test core and then the length of time that the test core will support the 50-lb. load at 1,080 deg. C. determined. Materials such as iron oxide, coal-dust, pitch, fly-ash, and silica-flour increase collapsing time.

Pattern Requirements

Much of the success of any precision-casting method depends upon the accuracy of the metal pattern. The pattern must be well designed, rigid and smooth (to 10 R.M.S.) and the dimensions held to ±0.001 with complete absence of any tool marks or other blemishes. The metal pattern should be mounted on a steel patternplate at least 1 in. thick.

The patterns may come within one inch of the outer perimeter of the "D"-process shell (Fig. 4). It has been found that one inch is adequate to seal the outer perimeter of a shell for horizontal pouring. In the case of vertical pouring, it is well to allow a 1¼-in. seal. Good practice is to allow a ¾-in. space between patterns; a space of from 1¾ to 2 in. is sufficient for a runner between two patterns, as shown in Fig. 4. Each pattern must be firmly fastened to the patternplate, making a fine, line contact with the plate at all points. Draft allowance may be zero, providing the height of the pattern does not exceed one inch. In other cases normal draft, such as two deg. is to be preferred but drafts of ¼ and 0 deg. are worked now for light castings on the exterior portion of the pattern. A general pattern layout and assembly is shown in Fig. 1. It should be noted that around the outer perimeter of the patternplate is attached a steel frame which is the same height as the thickness of the "D"-process core. The draft on this frame should be not less than 30 deg.

Stripping pins should be provided on each end of the pattern plate to guide accurately the carrier from the pattern in stripping. Every effort should be made to insure that one patternplate will form both the cope and the drag portion, as shown in Fig. 5, in which the top two rows of pattern form one half of a bearing plate while the lower two rows form the other half.

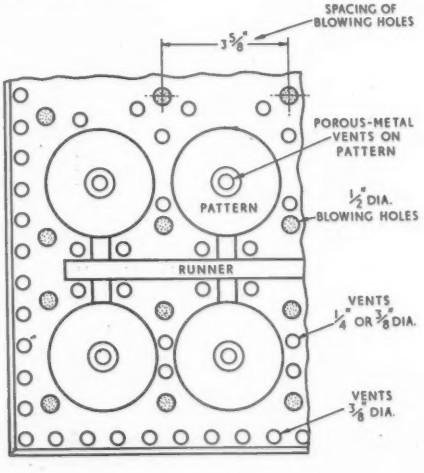
Gating

The gating of "D"-process patterns for horizontal pouring is shown in Fig. 6. The sizes of gates and runners are generally smaller than for normal green- and dry-sand practice. A runner pattern ⅞ to one inch on the plate side and ¾ to ⅞ in. on the top proves adequate for runners up to 15 in. long. The overall height of the runner in the "D"-process mould is 1 to 1½ in., feeding up to 40 castings in one mould. Such runners must be machined overall and form a surface that will promote easy lifting. The downgate for horizontal pouring may be from 1 to 1¼ in. dia. and should be provided with a pouring basin 3 to 4 in. dia. For vertical-mould pouring, the casting is generally larger and the downgate and horizontal runner can suitably measure 1-1¼ in. dia. (Fig. 7).

Venting Methods

A new venting practice is necessary to secure a firmly blown "D"-process core. The first principle to accept is that the core must be blown quickly—like a flash of lightning! Pattern wear is greatly reduced and a hard core is obtained. To accomplish this, one must follow an over-venting practice. The first step in venting a job is to vent the patternplate perimeter and patternplate frame, as illustrated in Fig. 8. Around the outer edge of patternplate and through frame plate holes should be drilled, ⅞ in. apart, for venting. It is preferable to use "D"-process vents ⅛-in. dia. and make certain that they are smooth on top and flush with plate surface so as to avoid sand sticking.

FIG. 11.—*Spacing of vents and blowing holes around a pattern.*



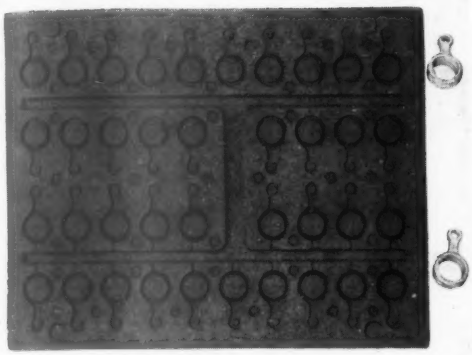


FIG. 12.—*"D"-process "drag" core, showing locators in each corner. (Castings shown on right.)*

There are two types of "D"-process vents in use. One is a stainless-steel wire-mesh screen of 150 mesh, as shown in Fig. 9. The other is a powdered-metal disc vent, as shown in Fig. 10. A fine-mesh screen, such as 150 mesh, is necessary to avoid clogging with the fine sand used. The stainless steel is hard and makes for a flat surface. The powdered-metal vent is mounted in a brass ferrule similar to the normal vent. The powdered-metal vent has the advantage that sand will not stick to it and its top surface may be smoother than a screen. However, the venting capacity of a powdered vent is lower than that of a screen vent, though the former may be placed on a pattern surface, if such be found necessary, without leaving a scar on the casting. This vent was developed by Mr. Alex Graham.[5]

Referring to Fig. 11, the spacing of vents around the pattern should be noted. Vents should be placed around the perimeter of each pattern and at each runner corner or pocket. A rule for placing a vent to every 2 to 3 in. around a pattern may be cited. Pockets in patterns must be vented to allow air to escape.

Blowing Holes

With blowing holes, here again one must accept the principle of fast blowing. This means the ample provision of blowing holes. At present, it seems desirable to employ a large number of conservative-sized blowing holes in preference to a small number of large blowing holes. Steel- or rubber-lined blowing holes, ½ to ¾ in. dia., have worked well. Spacing of blow holes to every three or four in. around the pattern is applied, as shown in Fig. 11. The blowing hole should project ⅛ in. beyond the face of the pattern-plate, so that at each hole there is a depression and not a projection—which would interfere with the mating of cores.

Location Arrangements

Two male and two female location points placed in each corner of a "D"-process core are used in cases where one plate makes both halves of a casting (Fig. 5). When two plates are used—one a cope and the other a drag—one plate is also provided with two male projections and two female depressions (Fig. 12). The locators are usually ½ in. high and have a bottom diameter of ¾ in. and top diameter of ⅝ in. Should a bare minimum of core-binder be used in the sand mixture, it is advisable to add a drop of core oil on each location point before baking.

Core Carriers

The purpose of the carrier is to form the back of the "D"-process mould. It is contoured around the pattern so as to form a space between them into which core sand may be blown. The illustra-

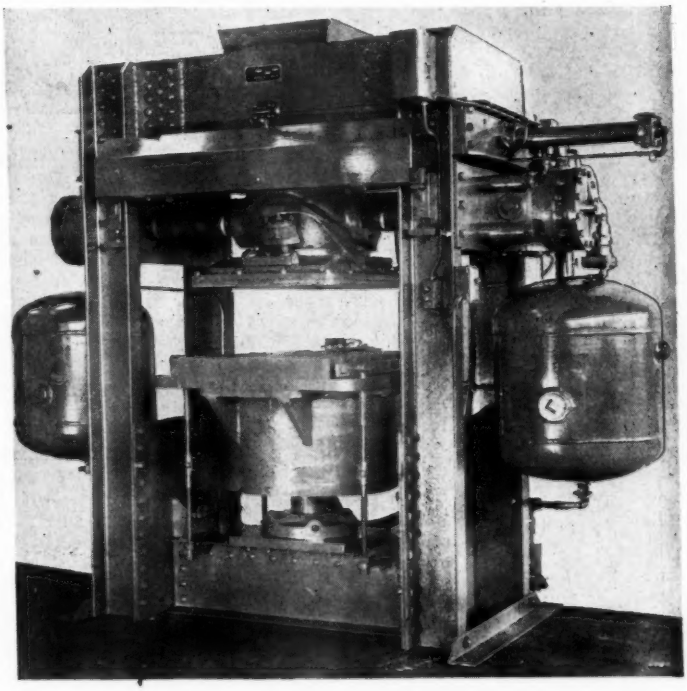


FIG. 13.—*Coreblower suitable for blowing "D"-process cores.*

FIG. 14.—*Blown "D"-process core lying in its carrier.*

tion in Fig. 1 gives details of a pattern assembly and carrier, the carrier being set under the pattern in the illustration. However, one can reverse this and blow through the carrier, having blowing holes extending through the carrier. This method slows up production, and is not at present in use. The carrier may be of grey iron or aluminium; the former permits higher baking temperature, such as 200 deg. C. The design of the carrier must receive careful study so as to have equipment that will not break or warp out of shape. This calls for the best practice in providing ribs of ample depth and size. The actual thickness of the carrier body need not exceed $\frac{1}{4}$ in.

The outer edge or perimeter and pin lugs must be strong. It is best to reinforce the outer edge with an additional thickness of metal, for example, to make the outer edge $\frac{1}{2}$ to $\frac{3}{4}$ in. thick or run a rib around the outer edge and then box the interior of drier with crossed ribs every four inches. The carriers are themselves cast, and their interior surfaces should have a draft not less than 5 deg. This interior surface is not machined, a good as-cast finish suffices. The flat surface formed by the carrier is disc ground or machined to a flat plane, but a warp of $\frac{1}{32}$ in. is permissible; also the bottom of the rib structure of the carrier is disc ground.

One round and one oblong hardened bush is inserted into each end of the carrier to receive the two stripping pins. The number of carriers required poses a problem in economics. Supposing one sets up to blow 250 cores per hour and a fast-baking oil is used, then 125 carriers will be required, cycling them at 30 min. each. To get accurate castings and prevent carriers tearing cores into pieces or producing a hair-line crack in a core during baking, it is necessary to blow into warm or hot carriers. No parting material is used on the carriers. On new carriers, machine oil may be used as a preparatory coating after which they are baked to secure a carbon coating.

FIG. 15.—*Back view of a "D"-process core for a crankshaft casting.*

Blowing Process

Any conventional coreblowing machine can be used to make "D"-process cores, providing it is equipped with a bottom air cylinder for drawing the carrier from the pattern. The draw mechanism should be in a good state of repair. The accuracy of the draw is controlled by means of the stripping pins. An air-vibrator of moderate size should be attached to the patternplate. A coreblower equipped with air reservoirs and capable of blowing "D"-process cores up to 40 in. long and 27 in. wide is shown in Fig. 13. It has a stationary sand chamber and a long, large draw-

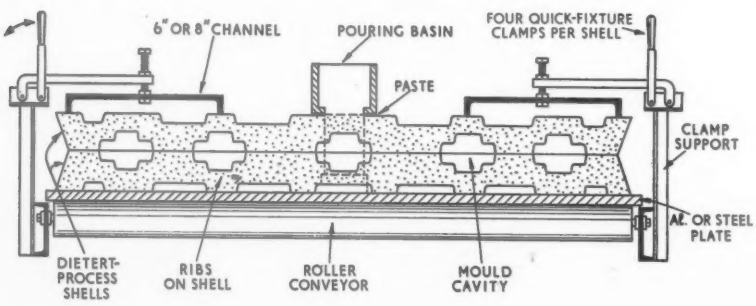


FIG. 16. — *Fixture clamping device for horizontal pouring.*

cylinder, making for accurate alignment between the patternplat and drawing table. The lowest production costs are obtained when cores of a relatively large surface area are used. For blowing cores measuring, for example, 24 by 36 in., coreblowers are equipped with large clamping cylinders which may well be 28 in. dia.

Air pressures of from 80 to 100 lb. per sq. in. are in use. The movement of drawing the carrier from the pattern should start slowly and then speed up to complete the draw. Large cores are cycled at 13 secs. through the coreblower. Coreblowers lend themselves to automatic cycling and feeding, an arrangement which fits into modern foundry trends. Carriers may be fed into and removed from a coreblower by means of air cylinders.

The pattern surface is cleansed with a liquid developed to suit each particular type of core-binder. No parting material is placed on the pattern surface, but it must be kept clean with a liquid solvent, for example—methylene chloride. A blown core—in a carrier—for a wheel hub is shown in Fig. 14. In Fig. 7 and Fig. 15 is shown a "D"-process core for a crankshaft and a "drag" core for the production of small connecting rods is shown in Fig. 12'.

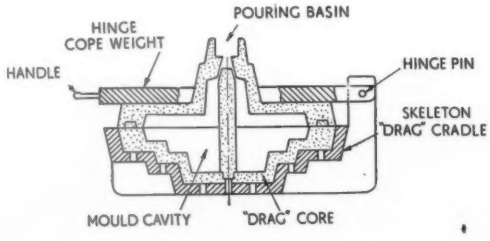
Clamping of Cores

Two "D"-process cores are placed together without any cement into a mechanical clamping device to hold the two cores firmly together and prevent a run-out or any warping, which would result in a distorted casting.

A simple clamping mechanism[6], which is proving very successful is shown in Fig. 16. The assembled cores are placed on an aluminium plate and are pushed into the pouring position. At this location are four fixture clamps for each mould. Each clamp is attached to the frame of the roller conveyor. On the clamping arm of the fixture is a length of channel beam. When an appropriate lever is depressed, the channel beam presses down firmly each corner section of the core and retains the whole in a flat plane against the bottom plate.

Another clamping device for a "D"-process core is shown in Fig. 17. The drag core is set into a skeleton cradle that rests on a conveyor table. The mould is then assembled and the top weight is swung on to the core, firmly holding it in position ready for pouring. When moulds are poured vertically, a movable cradle, locating on the moulds at

FIG. 17.—*Dead-weight clamping device for cores poured horizontally.*



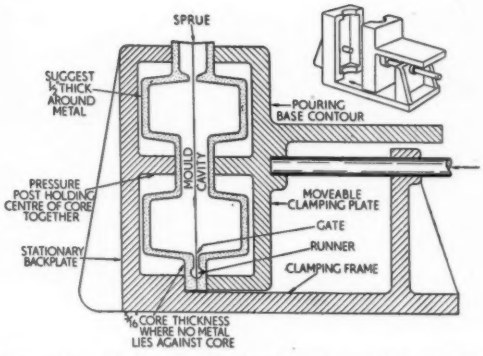


FIG. 18.—*Pneumatically-loaded clamp for vertical pouring.*

numerous places, presses the assembly against a stationary cradle. An illustration is shown in Fig. 18.

Finished Castings

The surface finish of castings made by the "D" process depends largely on the fineness of the core-sand employed. Dimensional tolerance is in the order of 0.005 in. per linear inch, which is the usual accuracy expressed for other precision casting methods. Each foundry and each casting design largely have their own optimum degree of accuracy. The surface finish of precision castings should be specified in R.M.S. The root mean square method is used in expressing the degree of machined surface smoothness. Foundrymen are to be encouraged to make use of this method for expressing the degree of finish of the casting. In the casting field, it is suggested that one is given a maximum R.M.S. value to express the greatest roughness that can be allowed at any small area and then another R.M.S. value to express the smoothness of the majority of the casting surface.

Conclusion

The Author considers that the number of castings made by precision casting methods will steadily increase. A general increasing demand is already evident for the precision-type of castings, and those present-day founders who have a precision-casting department will undoubtedly see it grow. Those founders who will not enter this field—supposing that they make castings that can be made with the process at a lower total cost—will lose business.

The Author's energies were directed into this field feeling that he could be of service to his chosen industry. He hopes this work may prove beneficial to the foundry industry either directly or by leading the way to a still better method.

REFERENCES

[1] *American Exporter Industrial*, January, 1954.
[2] Griffin Car Wheel Company, Chicago, Illinois.
[3] Eastern Clay Products Company, Chicago, Illinois.
[4] Archer-Daniels Midland Company, Minneapolis, Minnesota.
[5] Auto Specialities Manufacturing Company, St. Joseph, Michigan.
[6] Lakey Foundry Company, Muskegon, Michigan.
[7] Aristo Corporation, Detroit, Michigan.
[8] Director of research, Harry W. Dietert Company.
[9] French & Hecht Company, Davenport, Iow

New Welsh Foundry in Production

Full-scale production of ingot moulds and iron castings began on August 23 at the new Melincrythan, Neath, foundry of the Baglan Engineering Company (1919), Limited. The new plant, which took more than two years to build, on a site previously occupied by an obsolete tinplate hand-mill, replaces the company's Baglan works, which closed early in August after serving the Welsh iron and steel industry for more than 60 years by carrying out general engineering, welding, and patternmaking. Plans for the modernization of the Baglan works were drawn up in 1945, and following their rejection the company, which is a subsidiary of the Briton Ferry Steel Company, Limited, acquired the site of the new Melyn Works and adapted for foundrywork those parts of the old tinplate works which were still in good repair.

The erection of the new foundry, which will employ some 100 men, was considerably hampered by foundation difficulties, but finally the company began to transfer labour and plant from Baglan. First departments to move were the machine and welding shops, which began production at Melyn last year, fo'lowed early in 1954 by the bronze foundry and patternshops. The whole evacuation took some 18 months.

The main foundry, which has an area of more than 1,400 sq. ft., is traversed by a 25-ton overhead electric crane, and special equipment has been installed for the elimination of fumes and atmospheric dust. The cupola bay adjoins the foundry and houses two cupolas, each with an hourly capacity of 8 tons, arranged for alternate daily working. Their blowing fans are located beneath the stage, which is fed with raw material by a 5-ton overhead magnetic crane.

The new machine-shop, covering almost 1,000 sq. ft., is served by a 3-ton overhead crane and machine-tools have been installed at one end of the building to allow greater freedom of working in the smith's shop at the other end. The welding and fabricating departments are equipped with two 5-ton overhead cranes.

Two of the men who have played a prominent part in the reconstruction project have both served the company for 35 years. One of them is Mr. T. Afan Roberts, works manager and engineer, and the other Mr. C. W. Lewis, the company's secretary and accountant. The chief clerk, Mr. S. Duffield, is, in fact, the oldest member of the staff, with 39 years' service.

Two men with 38 years' service, Mr, D. J. Thomas, foreman moulder, and Mr. Cyril Butler, machine-shop foreman, have, with Mr. D. James, the foreman patternmaker, had the responsibility of operating the old plant, while also assisting with the construction of the new; another man who has been very active in preparing the Melyn Works for production is Mr. G. Beer, the yard foreman.

THE ALLEGATION that pollution to the atmosphere is being caused by the factory of the Sheepbridge Engineering Company, Limited, Chesterfield, is contained in a petition handed to the Town Clerk on August 18. The petition was signed by 1,000 residents of the Old Whittington district of Chesterfield and demands that steps should be taken to end the pollution of the atmosphere caused by smoke and grime. It has been stated by a Ministry of Health Inspector that all possible steps are a'ready being taken by the factory to control dust and smoke, but the residents hope to be able to have their case reconsidered.

Labrador Iron Ore for Scottish Steelworks

The first cargo of iron ore to Britain from the new deposits in Labrador reached the river Clyde last week in the ore carrier, Gleddoch. The cargo, which was loaded in eight hours, was discharged at Rothesay Dock, Clydebank, for the Clyde Iron Works, Tollcross, of Colvilles, Limited. The mineral, of a good semi-hematite quality, is suitable for Scotish blast-furnace practice, and a good share of the tonnage to be shipped across the Atlantic to Britain will be earmarked for Scottish use. The British Iron & Steel Corporation (Ore), Limited, the ore-importing organization of the British steelmakers, has placed contracts for up to 500,000 tons. The consignment was the second from the new field, being loaded after a cargo for the United States.

The development of the rich iron-ore fields of Labrador is mainly a joint British-American effort. The small port of Seven Islands, at the mouth of the St. Lawrence, was made into a modern rail terminal and exit port. A new railway, about 360 miles long, was laid to the Ungava region, and to speed up the work a large tonnage of materials and equipment was flown up country by air ahead of the tracks.

The Gleddoch was especially designed by Lithgows, Limited, Port Glasgow, for heavy ore traffic, and, completed in May of last year, carries over 8,500 tons. She is owned by Ore Carriers, Limited, and marks a new trend in the construction of special duty vessels. The four ore-holds are self-trimming and the hatches are designed for rapid loading and discharge.

Iron-ore Imports

Iron-ore imports in July and the total for the first seven months of this year compared with the corresponding period of 1953 are shown below.

Country of origin.	Month ended July 31.	Seven months ended July 31.	
	1954.	1953.	1954.
	Tons.	Tons.	Tons.
Sierra Leone	43,720	467,640	327,641
Canada	132,468	547,824	493,557
Other Commonwealth countries and Eire	14,439	143,664	29,885
Sweden	349,139	2,100,619	2,445,120
France	49,289	300,704	283,454
Spain	38,579	275,976	299,239
Algeria	238,681	1,085,153	1,317,887
Tunis	63,660	318,458	371,240
French Morocco	17,450	158,423	166,276
Spanish Morocco	16,525	180,529	166,871
Liberia	9,960	190,967	135,967
Brazil	37,685	171,538	248,760
Other foreign countries	104,348	339,449	627,481
TOTAL	1,115,943	6,280,944	6,913,378

Oil Industry Orders

British firms received orders for oil equipment and materials valued at over £39,000,000 in the first half of this year—an increase of nearly £3,000,000 over the corresponding period of 1953. Figures issued by the Council of British Manufacturers of Petroleum Equipment, on behalf of the Oil Companies Materials Secretariat, show that the largest single item in oil-industry orders was for bulk chemicals, which were valued at £10,735,400 for the half-year.

Enamel Finishes*

By W. T. Ebel

This Paper is intended as a review of the recent developments in the use and application of enamels at present being used by the enamelling industry. It is essentially of a general character, as it is impossible to explain all the techniques that are being carried on as they must be seen to be appreciated.

The development of new enamels, new processes and techniques has never been so important to the vitreous enamelling industry as it is at the present time. Now, competitive finishes and new consumer demands, are tending to force the enameller to ask more from his enamels—even what seems impossible. Only a few years ago, black specks, hair-lining, distorted table-tops, blisters round the weld of a handle to a pan—to mention just a few of the troubles—were quite happily being accepted by the customer at almost any price, but now the demand is for perfection—and at a lower price. This demand has, in its turn, been passed on to the enamel suppliers, who have endeavoured to produce the desired result, despite their own fight against the shortage of raw materials.

Desirable Characteristics

The enamels produced have not only to have proper acid resistance, with optimum workability, but are also expected to cure enamel-shop troubles, bad iron and many other things besides. These foolproof enamels have not yet been produced, at least, not to the Author's knowledge, but, with all the research that has been done, many new and good enamels have emanated, which are giving vastly improved results.

Most of the enamellers have realized their own shortcomings and, by improvement of design, intelligent handling and use of the new enamels, the standard of products has improved much. Many fields have been, or are being, lost to competitive finishes. Refrigerator doors and liners, previously vitreous enamelled, are being replaced by synthetic resins, which are tough, chemically resistant, economical and durable. Table tops, butchers' trays and wash bowls are now being produced in plastic which, although it may not have all the qualities of vitreous enamel, yet nevertheless has many advantages which make it attractive to the customer.

There are now new titanium enamels of very high opacity and perfectly adjusted coefficient of expansion which will enable any of these items to be processed without distortion and with the minimum of application. The American method of producing table-tops is something that could well be used in this country though, admittedly, it is more a matter of design that enamel superiority. Light-gauge steel is used and, after processing, the tops are pressed into cork or plywood panels in the same way that veneer is pressed on to wood. In this way the enamelled top is perfectly flat and has a substantial backing which helps to render it substantially resistant to chipping, when anything is dropped on it.

Until recently, holloware manufacturers have avoided using titanium-opacified enamels because, not only due to cost, their experiments with these enamels were not very encouraging, but, with the new types of titanium enamel on the market, these manufacturers are finding that they can process all their articles with almost the same "workability" as the older cryolite enamels and, in many cases, the same method of working is maintained, using two thin coats. In this way, the opacity of the "one coat" is obtained without its attendant worries of trying to produce perfect holloware in one operation, especially with present tooling. On the Continent, the larger holloware manufacturers have completely re-tooled their plants, eliminating the perrit marks to a large degree and, thereby, producing a very high proportion of ware having a single-coat finish.

Colours

It has always been very difficult to produce stable colours in titanium enamels, but, now, self-colour enamels with perfect stability in cream, green and blue are available, which are finding favour with many companies making proprietary articles and to whom stability of colour is of great importance. In particular, holloware manufacturers have found great application for their use, and, with the advent of the "contemporary kitchens," many other household-appliance manufacturers have had to turn their minds to colours other than white or cream. These enamels have a price equivalent to that of normal titanium enamels, thereby showing a saving as compared with the use of colouring oxides at the mill, which, in the case of some colours, amounts to about £20 per ton to frit. At the present moment the range of colours is limited but, no doubt, should the demand increase, further developments will bring a larger range. Self-colour enamels are not economical to produce in small quantities for the following reason: Either a smelter must be maintained for each colour, or else a considerable amount of cleansing must be carried out in order that all traces of the old colour are removed from the smelter before producing another colour. This is, of course, very expensive and it will be readily appreciated that the longer the smelter can be maintained on one particular colour the more economical it is.

The cooker industry is one which is continually striving for improved and cheaper finishes. Sensible designs, suitable for enamelling, have helped a great deal in assisting the modern enamels to play their full part. Improved titanium enamels have

* Presented at the Spring conference of the Institute of Vitreous Enamellers.

Enamel Finishes

gone a long way to eliminate brushing of edges, saving much labour cost and the black lines and corners which detract from the appearance of the finished article. Also, the coefficient of expansion of these enamels has been adjusted and the distortion of side panels and other parts has been reduced, making it far easier for subsequent handling by the fitting-shop—cutting down, at the same time, the amount of chipping that invariably resulted from this operation.

By the same development, and with the advent of the self-colour frits, sink units, washbasins, sheet-metal cisterns, to mention but a few items, have derived a new lease of production life from the fact that they can be made in acid- and alkali-resisting finishes and the thinner coating once more reduces the liability to chipping.

Interior Finishing

There has been a great change in interior finishing during the past few years, from sponge mottling and mottle on un-fired ground-coat, which was non-acid-resisting, to acid-resisting mottle on acid-resisting ground-coat or acid-resisting cover-coat. A new development in this sphere is the direct-to-iron self mottle grey or blue-grey ground-coat, which is acid-resisting and has excellent thermal-shock properties. Its adoption necessitates the use of a simple nickel-dip process or nickel-coated steel but, in all other respects, it can be either applied swilled or sprayed and also, should any article be damaged during processing, a further thin spray is sufficient to cover the defect without any variation of colour between single or double coats.

In one of the plants where this type of enamel has been working with great success, and where previously a two-coat interior enamel had been used, a very great saving in labour and fuel costs resulted, and at the same time, further capacity was available, due to the single firing technique.

Many companies are slightly deterred from the use of this enamel due to having to instal the nickel-dip process; they visualize that a chemist would need to be in constant attendance. This is not the case, for, in two plants where this type of enamel is largely used, the chargehand of the pickling plant is able to make any slight adjustments arising. A daily check on concentration is, of course, made by the laboratory, at the same time as the normal checks on the acid, etc.

Much has been written concerning the application in America of titanium enamels direct to titanium steel, but the cost of the latter item would more or less prohibit its use in this country, even if it became suddenly available. Therefore, applying ordinary commercial titanium enamels to normal enamelling iron has been among the British industry's research problems. This has been quite successfully done, though not on any substantial production scale and success is mainly as a result of careful preparation of the metal before application. There are various methods for doing this but a general idea is as follows:—

The metal is first cleaned by either shotblasting or a special, "sharp" pickling process followed by the nickel dip. This nickel deposit is non-galvanic and, therefore, iron does not go into solution. It gives a continuous nickel coat and a rough surface. Low-firing titanium enamels seem to give the best results and adherence is very good.

Recently, in the Author's laboratories, the possibility of producing a titanium-rich layer on the surface of the sheet metal has been investigated. Various soluble single and complex salts of titanium were used, first, in the electrolytic enrichment of the steel surface with lower oxides of titanium and, secondly, by gas reduction of titanium salts, again to give lower oxides and possibly some free titanium together with carbides and nitrides.

The second process appeared to be the most successful as, by first dipping the metal stock in a solution of a titanium salt and a wetting agent, grease was removed and a film of strongly-adhering titanium residue was obtained by gas pickling. Direct application of the commercial titanium enamels to these prepared surfaces gave infinitely better results than those obtained by coating ordinary pickled steel directly with the same enamels and there were no signs of "boiling" or discoloration. Adherence, as shown by impact testing, was very variable in this case but, by the use of a nickel dip before applying the enamel, excellent results were obtained. Attempts to co-reduce both nickel and titanium salts during gas pickling met with only limited success.

However, the control of operations required to produce the perfect base for the white enamel is very critical and it would appear to be some time before the process becomes a commercial proposition in the form stated.

Enamels for Cast Iron

With regard to cast-iron enamels, development does not appear to have taken place to the same degree as for sheet iron but general "workability" and acid-resisting qualities have been improved. Many plants are still producing lustre finishes with their own special ferric chloride formulæ, but the high gloss now obtainable with many of the normal enamels is tending to make them a more pleasing and durable surface. With cast iron particularly, the enamels are being asked to perform the apparently impossible and, in the Author's opinion, the standard of cast-iron enamels is far superior to the base on which they are required to be applied.

To sum up the position of the enamels in the field, it is felt that there are now some excellent enamels on the market, which are doing a great deal to help the enameller to produce a better article. With constructive criticism from the enameller and continued research by the supplier, there would seem to be no reason why the enamelling industry should not hold its place in the household-appliance field and, in fact, enter new spheres of application where an enamel surface would be an improvement.

In conclusion, the Author thanks the directors of Metal Porcelains, Limited, for permission to prepare this Paper and for the assistance provided.

Personal

Mr. M. G. MAYCOCK has been appointed civil engineer of the Scottish Region of British Railways, in succession to Mr. I. R. FRASER, who is retiring. Mr. Maycock was appointed assistant civil engineer in 1952.

Mr. J. C. SMITH, formerly sales engineer at the Glasgow branch of Crompton Parkinson, Limited, has been appointed the company's first resident manager in Central Africa, with headquarters at Salisbury, Southern Rhodesia.

MR. W. LAWSON HURDMAN is relinquishing his appointment as director and general manager of the Parkinson Stove Company, Limited, and associated companies, and DR. A. REES JONES has been appointed director and general manager, with effect from August 23.

MR. JOSEPH PRENDERGAST is shortly leaving Europe to return to his home at 278, Myrtle Street, Manchester, New Hampshire, U.S.A. Through this JOURNAL, he desires to express to his many friends in this country his sincere thanks for the many courtesies and kindnesses he has received.

A (1954) SCHOFIELD travel scholarship of the Institute of Production Engineers, for the best engineering student of the year, has been awarded to MR. W. R. BAILEY. He is an assistant departmental manager at the enginering works of Cowlishaw, Walker & Company, Limited, Biddulph.

MR. JOHN HENRY BLACKBURN, who has spent 57 out of his 69 years, with the Davy & United Engineering Company, Limited, was presented on August 29, with a cheque for £57 from the company and a wallet and money from workmates. The presentation was made by Mr. A. Fiennes, managing director.

THE Minister of Fuel and Power announced last week the appointment of MR. K. T. SPENCER as chief scientist of the Ministry in succession to SIR HAROLD ROXBEE COX. Mr. Spencer joined the Ministry of Fuel and Power in 1950 as deputy chief, under Sir Harold, of the Scientific Division that had been set up in 1948.

Mr. JOHN EDWARD HOLGATE has been appointed general manager of the Rhodesian Iron and Steel Commission. He has had wide experience in India, South Africa, Britain, and Germany, and is at present iron and steel consultant and technical adviser to the International Bank and the United Nations on the steel industry of Yugoslavia.

Mr. P. R. DUNN, deputy chief engineer of British Insulated Callender's Cables, Limited, has been appointed chairman of the Mersey and North Wales Centre of the Institution of Electrical Engineers. He is a past-president of the north-western branch of the Association of Mining Electrical and Mechanical Engineers and of the Manchester and District Branch of the Institute of Welding.

YORKSHIRE ENGINE COMPANY, LIMITED, Sheffield (branch of the United Steel Companies, Limited), announce that on September 9, MR. J. E. BAGGULEY will be appointed works manager. Mr. Bagguley is at present general production manager at the Distington Engineering Company, Limited, Workington, Cumberland. On the same date, MR. RUPERT LANCASTER, at present works manager, will be appointed general works manager at Distington Engineering Company, Limited.

MR. W. L. JOLLIE, chief accountant and assistant secretary of Stanton Ironworks Company, Limited, has been appointed chief accountant of Stewarts and Lloyds and all its U.K. subsidiaries as from August 19. As from that date he relinquished his previous position with Stanton Ironworks. He succeeds MR. J. W. CAMPBELL, who has been released from his appointment as chief accountant of Stewarts and Lloyds at the request of the Iron and Steel Holding and Realization Agency in order that he may continue as the Agency's financial adviser.

DR. IAN G. SLATER has been appointed head of the Metallurgy Department of Birmingham College of Technology with effect from September 1. Dr. Slater graduated in metallurgy with first-class honours at Birmingham University in 1925 and was awarded his M.Sc. in 1926 and Ph.D. in 1932. He is a Fellow of the Institution of Metallurgists and a Companion of the Institution of Mechanical Engineers. For the past five years, Dr. Slater has been director of research and development at T. I. Aluminium Limited, Birmingham. He has been research investigator at the British Non-Ferrous Metals Research Association and superintendent of the Admiralty Metallurgical Laboratories, Portsmouth, and a member of the Admiralty Delegation, Washington.

Obituary

THE DEATH HAS occurred of MR. ROY CHARLES BOLLARD, at the age of 31, chief designer in the oil-engine division at Rolls-Royce, Derby.

MR. JAMES NICHOLSON, Dunvegan, Denny, Stirlingshire, who died suddenly at Ostend while on holiday, was managing director of Carronbank Foundry, of Paul & MacLachlan, Limited, Denny. He was 48.

Mr. FRANK MASON, who founded Stainless Plating, Limited, in 1924, died last month at the age of 77. He remained technical director of the firm until a few weeks ago. For some time he was a lecturer in non-ferrous metallurgy at Sheffield University.

Prof. HENRY PASDERMADJIAN, Professor of Economic and Social Sciences in the University of Geneva, and an outstanding exponent of scientific business management, has died at the age of 50. For six years he was in the service of Aluminium, Limited.

Mr. J. CARMAN, chairman and managing director of Spark Alloys, Limited, has died at the age of 67. He was also a joint managing director of British Flint & Cerium Manufacturers, Limited, and managing director of the Carman Radio & Electrical Company, Limited.

THE DEATH occurred suddenly on August 27 of COLONEL HAROLD BANCOCK SANKEY, chairman of Joseph Sankey & Sons, Limited, of Bilston and Wellington. He was 59. Earlier this year Col. Sankey had relinquished the position of managing director to the company because of ill-health. He died after collapsing at his office at the firm's Bilston works. Son of the late Mr. G. H. Sankey, Col. Sankey graduated in the mechanical science tripos at Cambridge. He joined the firm in 1921 becoming managing director in 1935 and chairman in 1951. He was also a director of Guest, Keen & Nettlefolds, Limited, and of subsidiary companies. From 1942 to 1944 he was Midland Regional Controller of the Ministry of Production and was awarded the C.B.E. In 1952, he became president of the Birmingham, Wolverhampton and Stafford District of the Engineering and Allied Employers' Association. He was a Deputy Lieutenant of Staffordshire and High Sheriff in 1946.

News in Brief

ONLY MINOR DAMAGE to woodwork in the roof occurred at the foundry of Wright's Havelock Foundry Company, Limited, ironfounders, Leicester, as a result of a fire which occurred during the morning of August 28.

MORE THAN A HUNDRED tractors and agricultural machines were conveyed by three special trains from the works of Massey Harris, Limited, Kilmarnock, to Grangemouth Docks, en route to Istanbul, Turkey, recently.

THE SPORTS CLUB of Ruston and Hornsby, Limited, engineers, Lincoln, held their annual show for the first time on their own ground at Newark Road, Lincoln. The eight-hour programme was opened by Mrs. Riggall, wife of the managing director, Colonel H. B. Riggall.

AN ORDER for 25,000 electro-mechanical instruments, valued at £180,000, has been received by Venner, Limited, from the State of Victoria Electrical Commission. It is considered to be the largest single order for small precision instruments received by any European manufacturer.

AN INAUGURAL CONFERENCE for a "Special Study of Sulphur Removal and Recovery from Fuels" under the auspices of the Institute of Fuel, is to be held at the Institution of Mechanical Engineers, in London, on October 6 and 7. Dr. W. Idris Jones, president of the Institute, will take the chair at the opening session.

TUBE INVESTMENTS have announced an extension of its cycle manufacturing interests with the purchase of the name and goodwill of the James Cycle Company, Limited, whose founder produced "penny farthings." The group already control the Hercules Cycle Company and J. A. Phillips & Company, Limited, Smethwick.

UNEMPLOYMENT in Smethwick has reached "the irreducible minimum," Mr. J. E. Sitch, secretary of the Smethwick Local Employment Committee, reported to the committee on August 26. The number of vacancies for jobs reached a new record 641; short-time working has ended, and several firms are introducing extra shifts.

A FACT-FINDING COMMITTEE has been appointed in Birmingham by the National Union of Manufacturers to help firms to overcome problems in dealings with nationalized industries. It consists of leading industrialists and will discuss with the chief officials of nationalized concerns major problems and grievances arising locally.

CUXSON, GERRARD & COMPANY, LIMITED, Fountain Lane, Oldbury, Birmingham, announce that Mr. T. Lynch, of 104, Carter Drive, Havering Park, Romford, Essex, has been appointed representative for the counties of Norfolk, Suffolk, Essex, Middlesex, Hertfordshire, Huntingdonshire, Cambridgeshire, Bedfordshire and Buckinghamshire.

THE FOUNDATION STONE has been laid of a new factory for the Hamworthy Engineering Company, Limited, and its subsidiary, British Combustion Equipment, Limited, at Poole (Dorset). Production will commence in the new factory towards the end of the year, but the parent company has no intention of relinquishing its present premises.

COLVILLES, LIMITED, have taken control of Dixon's Ironworks, Limited, Glasgow, and the Atna Iron & Steel Company, Limited, Motherwell. This change will permit a further unification of the Scottish industry. Already Colvilles are responsible for about four-fifths of all the steel produced and about two-thirds of the pig-iron in Scotland.

PELAPONE ENGINES, LIMITED, Derby, has secured contracts from overseas worth £500,000 for power units to provide electricity for wireless telegraph and telephone networks. The units are miniature Diesel-engined power stations which can be left unattended for long periods in deserts, jungles and other isolated areas. The Japanese Telephone Corporation has placed orders with them valued at £90,000.

ROLLS-ROYCE, LIMITED, Derby, are acting hosts to 22 boys this week. Their programme includes a tour of the works—where they will see different engineering operations in progress—a series of lectures, and films. Most of the boys, who are from public and grammar schools, desire to make engineering their profession. During the week they will stay at the Rolls-Royce apprentices' hostel.

AN AGREEMENT has been concluded by the Fraser & Chalmers Engineering Works of the General Electric Company, Limited, manufacturers of mining machinery, etc., with the Humphreys Investment Company of Denver, Colorado, U.S.A., to be the selling agent respecting the sales of Humphreys' spiral concentrators for delivery to the U.K., the Gold Coast, Gambia, Sierra Leone, Nigeria, Burma, India, and Pakistan.

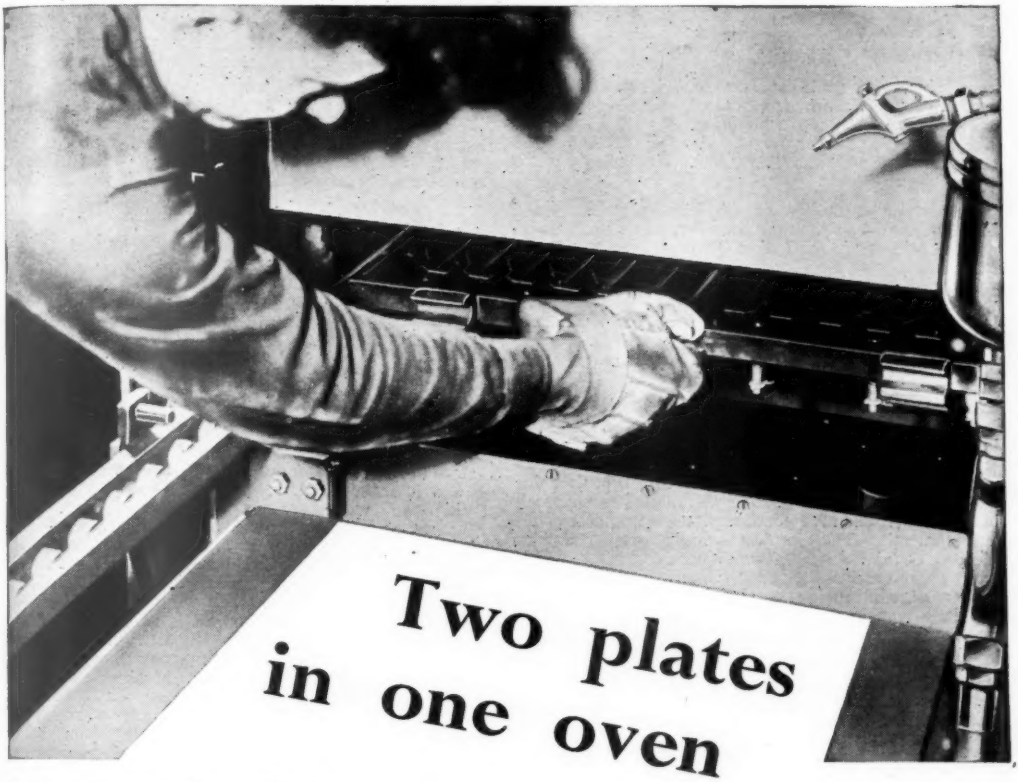
THE FIRST VISIT under the Falkirk, Grangemouth & District Productivity Committee circuit scheme took place recently, when a team from Allied Ironfounders, Limited, visited Grangemouth and Linlithgow as guests of I.C.I. Limited. The visiting team, eight in number, were representatives of Falkirk Iron Company, Limited, Forth & Clyde & Sunnyside Iron Company, Limited, Dobbie, Forbes & Company, Limited, and M. Cockburn & Company, Limited.

FIRST EXPORTS of high-grade uranium oxide to Britain and the United States from South Australia will be shipped early next year, according to the state's Prime Minister, Mr. Thomas Playford. He said South Australia's £5,000,000 uranium mine and concentration plant at Radium Hill would begin full production in seven or eight weeks. First tests at the Mary Kathleen uranium lease, near Mount Isa, Queensland, have indicated a field of one square mile containing 1,350,000 tons of high-grade ore.

MR. JOHN LUND has terminated the manufacturing arrangements for the Hydro-Tracer profiling and copying valve which he had with Hayes Engineering (Leeds), Limited, and has joined the machine-tool division of Fairbairn Lawson Combe Barbour, Limited, Leeds. To this firm he has delegated all patent rights in respect of the copying valve, with the object of developing profiling and copying equipment as conversions to existing machinery, special copying and profile machines and special machine-tools generally.

NEW INDUSTRIAL TELEVISION EQUIPMENT, including a small lightweight camera, has been produced by Marconi's Wireless Telegraph Company, Limited. Among its uses is that of monitoring at a central control office various instruments located in widely separated points of a factory. It is claimed that many industrial processes such as tests-to-destruction, the study of the combustion conditions in a boiler, or even assessment of the amount of smoke coming from a factory chimney can now all be viewed from the security of an office.

POWERS-SAMAS ACCOUNTING MACHINES, LIMITED, have announced that owing to the large increase in sales of their products at home and abroad, it has become necessary to expand production, and negotiations are now at an advanced stage whereby the company will

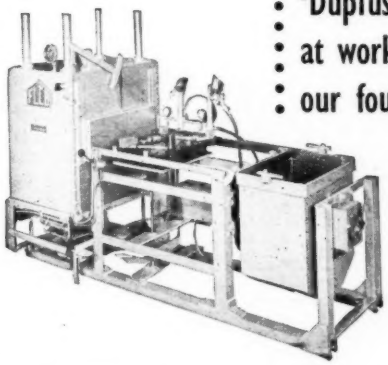


Two plates in one oven

The single oven of the Shelmolda Duplus does the work of two. While one shell is being cured the other patternplate is being invested with a new shell. Because of this unique feature the operator's "time and motion" is reduced and the floorspace required is kept down to 8ft. 6in. by 3ft. 3in. Can you get, anywhere, a greater output, or a lower running cost in a machine at this price?

OUTPUT: 50/60 moulds per hour. *DELIVERY:* 8/10 weeks. *PRICE:* £575.

May we show you the Shelmolda 'Duplus' at work in our foundry?



Shelmolda

DUPLUS

(Patent Applied For)

Originated and manufactured by

FAIRBAIRN LAWSON COMBE BARBOUR LTD., LEEDS, ENGLAND Telephone: LEEDS 32041

236,61

News in Brief

take over additional capacity to be made available by Vickers-Armstrongs, Limited. To deal with the increased scope of the business, Mr. R. Wonfor has been appointed managing director (sales, finance, and research) and Mr. T. R. Swift managing director (production).

PLANS FOR EXPANSION of the Indian iron and steel industry have been announced by Mr. K. C. Reddy, Production Minister in the Indian Government. Mr. Reddy said that a new steel project at Rourkela, in Orissa, would be in operation at the end of 1958. Initial capacity would be 500,000 tons of steel a year, to be stepped up later to 1,000,000 tons. Another steel plant was also planned. Other industrial development included two more fertilizer plants, a pilot project for the manufacture of aero engines to be set up at Bangalore, and factories to manufacture heavy electrical equipment.

THE NATIONAL UNION OF MANUFACTURERS, the Midland-area secretary of which is Mr. E. Holden, has convened a meeting in Birmingham on September 28 at which heads of firms will consider a project for grouping in "colonies" round Birmingham's proposed inner ring road of new factories displaced by redevelopment. The project would cost between £15,000,000 and £14,000,000. Some 56 firms have already expressed interest in the scheme. Sixteen colonies are envisaged, ranging in size from 20 to 50 acres. Buildings would be four-storeys high and each group would take from 20 to 50 firms.

GENERAL ELECTRIC COMPANY, LIMITED have been entrusted by Richard Thomas & Baldwins, Limited with a contract valued at £238,000 for electrical plant and equipment for the Ebbw Vale steelworks, where an existing 3-stand tandem cold mill is to be converted into a 4-stand mill. The order covers two 3,000 h.p. and one 750 h.p. twin-armature d.c. motors, a six-machine motor-generator set driven by a 9,000 h.p. 11 kv. synchronous motor, and all the associated a.c. and d.c. switchgear together with control gear embodying G.E.C. control exciters. The electrical plant and equipment for the original mill, which has been in service since 1938, was also supplied by the same company.

BRITISH INSULATED CALLENDER'S (SUBMARINE CABLES) LIMITED—with an authorized capital of £250,000—has been formed by British Insulated Callender's Cables Limited and W. T. Glover & Company, Limited, to specialize in the design and manufacture of submarine power cables. The registered office of the Company is Norfolk House, Norfolk Street, London, W.C.2, and the works are at Trafford Park, Manchester. During most of 1955, the company will be occupied with the manufacture of approximately 77 miles of 138 kv, 0.35 sq. in. gas-filled submarine power cable for the British Columbia Electric Company, Limited, of Canada, to the order received by British Insulated Callender's Cables, Limited.

NINE LEADING ARCHITECTS have been invited by the English Electric Company, Limited, to take part in a limited competition for planning a new building on the site of the old Gaiety Theatre in London. This building will, with Marconi House, form the enlarged offices of the English Electric group. The Gaiety is part of the centre island block of buildings at Aldwych. It was closed as a theatre before the war and has stood empty ever since. Repeated attempts have been made over a period of years to revive the building as a theatre, but this was found to be impossible and the English Electric Company bought the site. The company states that it is mindful of the importance of the site and regards it as part of its public duty to erect a fine, modern building.

BRITAIN has completed a trade agreement with Hungary covering the 12 months from September 1. Under this arrangement Hungary has been given the opportunity to re-establish her trade with the U.K. as a preliminary to negotiating before September, 1955, settlements in respect of Hungary's liabilities for debt, nationalization, and expropriation of British property and Peace Treaty claims. In the meantime, Hungary will proceed with the examination of U.K. claims. Quotas for U.K. exports to Hungary, have been agreed to an approximate value of £5,000,000; the main exports will include machinery, vehicles, tinplate, and electrical machinery and equipment. Hungarian exports to Britain have been agreed to an approximate value of £5,500,000, comprising mainly foodstuffs.

Weir Group at Kelvin Hall

The Weir group of companies, under the parent firm of G. and J. Weir, Limited, Cathcart, Glasgow, is represented in two stands at the Scottish Industries Exhibition at Kelvin Hall, Glasgow. A large stand of 900 sq. ft., facing the main entrance of the exhibition, gives prominence to land and marine power-plant auxiliaries of the group, valves for special duties, and factory-built permanent houses. A second stand in the engineering section is devoted to the products of Drysdale & Company of Yoker.

One feature on the main stand is an animated flow-diagram of the Weir closed-feed system for ships. This shows in section form all the units in the main and auxiliary feed systems, and the flow of water and steam under various working conditions. Push-button control, in addition to automatic operation, allows any particular condition to be retained for demonstration, after which the flow returns to automatic operation in cycles. Harbour service and manœuvring, normal full-speed running, "crash stop," and automatic regulation of the quantity of de-aerated feed water in the system under all conditions, are all visually demonstrated.

Other products of the Weir parent company, illustrating important contributions to the nation's export drive, are displayed in models of sea-water evaporating plants, regenerative condensing plant, de-aerators, turbine-driven pumps, etc. A valve for the chemical industry, which can comfortably be held in the palm of the hand, is part of the display by Weir Valves Limited. Another part of the display, in interesting and striking contrast, is of larger, special-duty valves of unusual design, made of highly-polished aluminium.

Weir Housing Corporation Limited, is an important member of the Weir Group, with activities quite distinct from the engineering companies. They make permanent houses in their factory at Coatbridge, and transport them in sections for erection at sites where work has been going on simultaneously in preparing roads, services and foundations. A model of a complete housing scheme, similar to those laid out by the firm, is on the stand, and shows every type of house and flat built by Weir's. A booklet "Civilizing Influences," specially printed for the exhibition, describes how the products of the Weir group affect everyday life in all parts of the world. Copies of the booklet in Spanish are also available to assist the export drive in Spanish-speaking countries. Buyers, unable to visit the exhibition, can obtain these booklets by writing to the firm.

Mr. SIDNEY JAMES CORMACK, yard foreman engineer of William Denny & Bros., Limited, shipbuilders and engineers, of Dumbarton, died last Friday.

F.&M. FERRO-SILICON BRIQUETTES

F. & M. SILICON BRIQUETTE

It is well known that the hardness of ordinary cast iron depends to a large degree on the Silicon content of the metal. Silicon acts as a softening agent in cast iron by its action in reducing the amount of combined carbon, which is liberated in the form of free graphite. The presence of free graphite and a low combined carbon content contribute towards easy machineability.

For the past twelve years, F. & M. Supplies Ltd. have provided in their Ferro-Silicon Briquettes a PRACTICAL, CONVENIENT AND ECONOMICAL means of increasing the amount of Silicon in a cast iron. The necessary number of Briquettes is added to the charge in the Cupola and all the Silicon contained in the Briquettes passes into the molten metal with only a negligible loss *because the element is protected during its progress through the oxidising zone.*

An important function of **F. & M. Ferro-Silicon Briquettes** is in the production of dense iron castings with high tensile strength. The foundryman usually ensures sufficient "softness" in his castings by using a pig iron with 3 to 4 per cent. Silicon. Such pig irons are frequently coarse-grained with large graphite flakes and, when used in ordinary cupola mixtures of pig and scrap iron, are apt to give rise to castings containing large graphitic flakes. This coarse-grained structure, which is particularly developed in the thicker parts of the section, results in an iron of comparatively low tensile strength.

By using pig irons of medium Silicon content (2 to 2·5 per cent. Silicon) which possess a denser structure owing to their smaller graphite flakes, and increasing the Silicon content of the metal by an appropriate addition of **F. & M. Ferro-Silicon Briquettes** to the cupola mixture, an iron with much smaller graphite flakes and, therefore, with a denser structure, is produced. At the same time, the metal is readily machineable, although it is denser and stronger, ***as the composition of the metal remains unaltered from that obtained by the use of higher Silicon coarse-grained pig irons.***

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Raw Material Markets

Iron and Steel

Although activity in the light-castings trade continues to expand, so far the furnaces are having no difficulty in supplying enough high-phosphorus iron to meet requirements. But the position may be a little tighter in a few weeks' time—particularly if the trade keeps on improving—as another Derbyshire furnace will be out for relining at the end of this month. The heavy engineering, jobbing, and speciality foundries continue to be well engaged; in fact, some are extremely busy and it is by no means easy to cover their demands for low- and medium-phosphorus iron. The call for hematite pig-iron continues to grow and consumers could do with bigger supplies of this iron in high-silicon content. A stronger demand has also developed for refined pig-iron, presumably because of the shortage of blast-furnace low-phosphorus iron.

Coke allocations are being delivered with little or no delay except that supplies of special coke from the South Wales area are subject to occasional hold-up.

As the re-rollers are somewhat busier than they were, the demand for billets and slabs, particularly the latter, is keeping up to a good level. The Welsh and English makers are unable to meet the demands from the re-rollers and thus avoid the necessity of getting imported supplies. The billet makers, too, are disposing fairly readily of their supplies of crops and seconds. The sheet trade is extremely busy, having substantial orders for home and export. There is a good demand from the hand mills for sheet bars; this is being met without undue difficulty.

Non-ferrous Metals

Against a background of widespread strikes at copper mines in Chile and the United States, coupled with plans for more intensive stockpiling of lead and zinc, it is not surprising that the tone on the Metal Exchange last week was decidedly strong. In tin and lead the rise was relatively modest and both lead and zinc closed below the best levels reached. Tin has now suffered a prolonged fall from the quotation early in July, which was above £750, but other metals, and, indeed, many commodities, have appreciated during the past two months.

Should the U.S. Government's stockpiling plans come to fruition, upwards of 200,000 short tons of lead and 300,000 tons of zinc will be added to the stockpile by June 30 next year. Trade stocks of zinc are, however, heavy in the United States at present, and sentiment regarding the price prospects for this metal is not bullish. No change has been made in the U.S. quotation of 11 cents, equal to about £88, but lead moved up by ¼ cent to 14¼ cents, equal to £114. In London zinc gained £3 5s. for August and £3 for second half November, trading finishing the week with a backwardation of 5s., a development which it is not easy to account for. There are reports that the high-grade zinc premium, now standing at £6, is likely to be reduced in the near future.

Copper showed strength last week, gaining £3 15s. for cash and £1 15s. for three months, the backwardation widening to £3 10s. There was some keen bidding for the cash position during some of the sessions, but there was also some evidence of hedging sales of forward copper. The position, with such a severe reduction in world production, is certainly serious, and should the strikes continue long the problem of supplies may become acute. No doubt in need there would be a release from the U.S. stockpile, but that would not help here. On a total copper basis, commercial stocks of virgin copper in the U.K. are equal to about two months' supply. Fortunately, there is no sign of trouble in Rhodesia and Canada. In tin last week there was a gain of £3 in both cash and forward positions.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* August 26, £240 10s. to £240 15s.; August 27, £240 15s. to £241; August 30, £240 10s. to £240 15s.; August 31, £239 10s. to £240; September 1, £243 10s. to £244.

Three Months: August 26, £237 10s. to £237 15s.; August 27, £237 to £237 5s.; August 30, £237 10s. to £237 15s.; August 31, £236 10s. to £236 15s.; September 1, £238 to £238 10s.

TIN, Standard—*Cash:* August 26, £732 to £733; August 27, £730 10s. to £731; August 30, £730 to £730 10s.; August 31, £728 to £730; September 1, £731 to £732.

Three Months: August 26, £731 to £732; August 27, £730 10s. to £731; August 30, £730 to £731; August 31, £727 10s. to £729; September 1, £730 10s. to £731.

ZINC—*August:* August 26, £77 10s. to £77 15s.; August 27, £77 15s. to £78; August 30, £77 2s. 6d. to £77 5s. *September:* August 31, £77 10s. to £77 15s.; September 1, £78 2s. 6d. to £78 5s.

Second half November: August 26, £77 10s. to £77 15s.; August 27, £77 15s. to £78; August 30, £77 5s. to £77 10s. *First half December:* August 31, £77 10s. to £77 15s.; September 1, £78 to £78 5s.

LEAD—*Second half August:* August 26, £99 5s. to £99 10s.; August 27, £98 5s. to £99; August 30, £99 5s. to £99 10s.; August 31, £98 15s. to £99. *First half September:* September 1, £98 15s. to £99.

Second half November: August 26, £97 10s. to £97 15s.; August 27, £97 5s. to £97 10s.; August 30, £98 to £98 5s.; August 31, £97 to £97 5s. *First half December:* September 1, £97 to £97 10s.

Allied Angling

Twenty-seven members of Allied Ironfounders' Angling Club travelled by special bus from Falkirk for the seventh and final competition for the Hill Cup on a four-mile stretch of the River Dochart recently. Weather conditions were dull and cloudy. Trout caught totalled 10, weighing 3 lb. 10 oz.

The prize-winner for the club competition was P. Buchanan (Callendar Abbots), 1 lb. 2 oz.; heaviest fish 9 oz. (equal) D. Cox (Allied office), and T. Anderson (Falkirk Iron Works). Final total, Hill Cup—(1) A. Reid, 6 lb. 9 oz. (equal) (Dobbie, Forbes & Company, Limited); (2) D. Cox, 5 lb. 6 oz. (Allied office); (3) G. Craig, 4 lb. ½ oz. (Callendar Abbots); (4) (equal) J. Wright (Callendar Abbots) and A. Morrison (Forth & Clyde & Sunnyside Iron Company, Limited), 3 lb. 1 oz.

Latest Foundry Statistics

According to the Council of Ironfoundry Associations, the number engaged in ironfounding in this country at July 3, was 139,002 (129,511 males and 9,491 females). This figure shows a decline of 825 as compared with a month previous. A year earlier, total employment stood at 141,484.

According to British Bureau of Non-Ferrous Metal Statistics, the output of copper-base castings during June was 4,807 tons. For the first half year the production was 31,198 tons as compared with 24,636 tons for the same period in 1953.

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(XD 934D)

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

September 1, 1954

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £14 19s. 6d.; Birmingham, £14 12s. 9d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 5s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 16s. 9d.

Scotch Iron.—No. 3 foundry, £17 9s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 19s. 6d.; South Zone, £19 2s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 19s. 6d.; South Zone, £20 2s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £17 14s. 6d.; Scotland (Scotch iron), £18 1s. 0d.; Sheffield, £18 19s. 0d.; Birmingham, £19 6s. 6d.; Wales (Welsh iron), £18 1s. 0d.

Basic Pig-iron.—£15 10s. 6d. all districts.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots).—40/55 per cent., £42 0s. 0d., basis 45 per cent. Si, scale 17s. per unit; 70/84 per cent., £65 0s. 0d., basis 75 per cent. Si, scale 18s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £185 9s. 0d. to £195 0s. 0d. per ton; 38/40 per cent., £251 0s. 0d. to £270 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 13s. 4d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 16s. 4d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £75 0s. 0d. to £80 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £74 0s. 0d. to £76 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; max. 2 per cent. C, 1s. 7½d. per lb. Cr; max. 1 per cent. C, 1s. 8d. per lb. Cr; max. 0.15 per cent. C, 1s. 9½d. per lb. Cr; max. 0.10 per cent. C, 1s. 9¾d. per lb. Cr; max. 0.06 per cent. C, 1s. 10d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 6½d. to 7s. 1d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £255 0s. 0d. to £262 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £54 15s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C, £26 12s. 6d.; hard (0.41 to 0.60 per cent. C), £28 0s. 0d.; silico-manganese, £33 16s. 0d.; free-cutting, £28 16s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 12s. 0d.; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 0s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £32 9s. 0d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 7s. 0d.; flats, 5 in. wide and under, £32 7s. 0d.; hoop and strip, £33 9s. 0d.; black sheets, 17/20 g., £42 1s. 0d.; galvanized corrugated sheets, 24 g., £51 8s. 6d.

Alloy Steel Bars.—1 in. dia. and up; Nickel, £53 8s. 0d.; nickel-chrome, £75 2s. 0d.; nickel-chrome-molybdenum, £84 13s. 6d.

NON-FERROUS METALS

Copper.—Cash, £243 10s. 0d. to £244 0s. 0d.; three months, £238 0s. 0d. to £238 10s. 0d.; settlement, £244 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 27⅞d. per lb.; wire, 269s. 3d. per cwt. basis; 20 s.w.g., 301s. 0d. per cwt.

Tin.—Cash, £731 0s. 0d. to £732 0s. 0d.; three months, £730 0s. 0d. to £731 0s. 0d.; settlement, £732 0s. 0d.

Zinc.—September, £78 2s. 6d. to £78 5s. 0d.; first half December, £78 0s. 0d. to £78 5s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £107 10s. 0d.; rolled zinc (boiler plates), all English destinations, £105 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £96 0s. 0d.

Lead (Refined Pig).—First half September, £98 15s. 0d. to £99 0s. 0d.; first half December, £97 0s. 0d. to £97 10s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 22⅞d. per lb.; rods, drawn, 32½d.; sheets to 10 w.g., 259s. 6d. per cwt.; wire, 30¼d.; rolled metal, 245s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £166; B6 (85/15), £210; BS249, £174.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £200; HTB2 (38 tons), £210; HTB3 (48 tons), £223.

Gunmetal.—RCH, 3/4 per cent. tin, — ; BS1400, LG2 (85/5/5/5), £198; LG3 (86/7/5/2), £208; G1 (88/10/2/½), £280; (88/10/2/1), £266.

Phosphor Bronze.—BS1400, PB1 (AID released), £289 per ton.

Phosphor Bronze Strip, etc.—Strip, 366s. 6d. per cwt.; sheets to 10 w.g., 389s. 0d. per cwt.; wire, 45½d. per lb.; rods, 33¾d.; tubes, 38d.; chill cast bars: solids 40d., cored 41d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 1¾d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 7d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 6d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £100 0s. 0d. Nickel, £483 0s. 0d. Aluminium, ingots, £156 0s. 0d.; aluminium bronze (BS1400), AB1, £250; AB2, £260, Solder, brazing, BS1845, 1s. 11d. lb.; granulated, 2s. 2d. lb.